CONTENTS

LETTERS

ARTICLES

LETTERS

COMMENTS ON THE
CHANGING FORMAT

The October, 1982 issue of the *Journal of the Alabama Academy of Science* was a pleasant surprise. I would like to congratulate you on this amazing improvement. Not only was I impressed with the beautiful cover, but with the quality of the two articles in that issue. Hopefully this would encourage the membership in the Academy to consider our *Journal* as an appropriate place to publish their research efforts. I would hope your editorial board will be able to accept more articles in the future, in order that the *Journal* can grow.

I am taking advantage of your improvement by writing this letter to the Editor. The 'In Memoriam' section is also an excellent idea, but I do not plan to take advantage of that section of the *Journal* in the near future.
Edwin R. Hughes, MD
University of South Alabama
College of Medicine

Just a note to tell you that I have just received my October, 1982 issue of the "new" *Journal of the Alabama Academy of Science*, and to say that it is a great improvement over previous issues. I particularly like all of the new ideas that are being incorporated and want to add my support to the work that you are doing.
Joseph C. Thomas, Dean
University of North Alabama
School of Arts and Sciences

I am writing to heartily commend the editorial staff of the *Journal* on the recent format changes. The letters section should not only serve to facilitate communication among academy members who may not otherwise have the opportunity to exchange ideas, but has the potential to increase the overall impact of the *Journal* on its diverse readership. The inclusion of review articles such as the one authored by D. E. Rymal and G. W. Folkerts was most stimulating, and I look forward to seeing more of the same.

I would appreciate clarification on the editorial policy concerning the submission of color photographs for use on the cover. The editor stated that he, "will accept for consideration any color photograph, ...that interested persons wish to submit", which gives me the indication that future covers may portray subject matter that is irrelevant to that contained within the body of a particular issue. I hope that if this is the intention of the editor's message, every effort would be made to first secure photographs that are connected with the articles at hand and use others only in the absence of such. Such preferential treatment would allow authors the rare opportunity to exhibit specimens and pertinent data in a manner that few journals can afford.
Robert S. Lishak
Associate Professor
Department of Zoology-Entomology
Auburn University

Lishak's point is well taken. Whenever possible, cover photographs will relate to one of the articles in that issue. However, we anticipate situations in which the articles in a particular issue do not lend themselves to color illustrations, or authors do not submit usable material. In these cases we will use the most interesting and attractive photograph that is availiable.
Editor

ON FOURTH MOMENT LIMITS REQUIRED TO ACHIEVE .01 ACCURACY OF NORMAL APPROXIMATION FOR SYMMETRICAL LINEAR COMBINATIONS

Saeed Maghsoodloo and James H. Hool
Department of Industrial Engineering
Auburn University, AL 36849

INTRODUCTION

Consider the simple linear combination (LC)

$$S_n = X_1 + X_2 + \ldots + X_n, \; n \geq 2 \qquad (1)$$

where the X_i $(i=1,2,\ldots,n)$ are independent random variables (RV's) with means, μ_i, variances, σ_i^2, standarized third moments, α_{3_i}, and standardized fourth moments, α_{4_i}. If the X_i are symmetrically distributed (i.e. $\alpha_{3_i} = 0$ for all i) then S_n is also symmetrically distributed with mean

$$E(S_n) = \sum_{i=1}^{n} \mu_i, \; \text{variance } V(S_n) = \sum_{i=1}^{n} \sigma_i^2, \; \text{standardized}$$

third moment $\alpha_3 (S_n) = 0$, and standardized fourth moment

$$\alpha_4 (S_n) = \frac{\sum_{i=1}^{n} \mu_{4_i} + 6 \sum_{i=1}^{n-1} \sum_{j>i}^{n} \sigma_i^2 \sigma_j^2}{\left[\sum_{i=1}^{n} \sigma_i^2 \right]^2} \qquad (2a)$$

where μ_{4_i} is the fourth central moment of X_i.

It has been shown [4] that if not all of the X_i in (1) are normally distributed, then a lower limit on n (i.e. the minimum number of X_i in S_n) can be determined such that (1) is approximately normally distributed. For the case where all X_i are symmetrically distributed the value of n is determined from

$$\left| \alpha_4 (S_n) - 3 \right| \leq \epsilon_4 \qquad (3)$$

where ϵ_4 is a specified small positive real number. Furthermore, when X_i's are symmetrically and identically distributed, equation (2a) reduces to

$$\alpha_4 (S_n) = \frac{\alpha_4 (X) - 3}{n} + 3 \qquad (2b)$$

---

where $\alpha_{4}(X)$ is the standardized fourth moment of each X_{i}, i=1, 2,...,n. Combining (2b) with (3) results in

$$n_{min} \geq \frac{|\alpha_{4}(X) - 3|}{\varepsilon_{4}} . \qquad (4)$$

Obviously, the smaller ε_{4} is specified then the better the resulting normal approximation.

This paper deals with determining the relationship between ε_{4} in (3) and the accuracy of normal approximation of (1) and in particular determining a threshold ε_{4} value to achieve a desired normal approximation accuracy. Accuracy is defined as the maximum absolute deviation of the exact cumulative distribution function (cdf) of S_{n} and the cdf of the equivalent normal distribution (END) of S_{n}, i.e. the Kolmogorov statistic [1]. The END is a normal density with mean $\mu(S_{n})=\mu_{n}$ and variance $V(S_{n})=\sigma_{n}^{2}$ and is denoted by $N(\mu_{n}, \sigma_{n}^{2})$. Accuracy has been set at 0.01, and the objective is to determine an upper limit on ε_{4} to achieve a 0.01 accuracy for the normal approximation. This level of accuracy was chosen because when the exact cdf and the equivalent normal cdf differ by at most .01, then the approximation should be adequate for most practical purposes. An accuracy level of .001 was initially considered but led to impractically large n values (n>100).

Hitherto only somewhat vague guidelines [3] have been given to determine n in (1) so that S_{n} is approximately normally distributed. The results contained in [4] in combination with results in this paper more definitely quantify the Central Limit Theorem [2] for symmetrical X_{i}'s.

PROCEDURE

Four types of symmetrically distributed X's in (1) were considered namely (a) the binomial with p= 1/2, (b) non-standard empirical discrete RV's, (c) the uniform and (d) the double exponential. For each type of RV and value of n, the exact frequency function of S_{n} was developed by appropriately convoluting the frequency function, f, of X and then computing

$$D_{max} = \frac{Sup}{all \ y} \ |F(y) - \Phi(y)| \qquad (5)$$

where $F(y)$ = cdf of S_{n}, $\Phi(y)$ = cdf of END and y is in the domain of S_{n}. The value of n was successively increased until $D_{max} < .00999$. At this value of n, say n´, the 0.01 normal approximation accuracy was achieved. Then, using n´, $\alpha_{4}(S_{n})$ was computed from which ε_{4} was determined as $\varepsilon_{4} = |\alpha_{4}(S_{n´}) - 3|$. A global maximum value of ε_{4} was then selected from the set of all ε_{4} obtained from the analyses for all four types of RV's. In total one RV of type (a), 305 RV's of type (b), one RV of type (c), and the whole family of RV's of type (d) were considered. Analyses and results for each type of RV considered are discussed individually.

2

BINOMIAL DISTRIBUTION ANALYSES/RESULTS

A set of n Bernoulli trials in (1) results in S_n having the binomial frequency

$$b(x) = \binom{n}{x} p^x (1-p)^{(n-x)}, \quad x=0,1,2,\ldots,n \qquad (6)$$

where p = probability of a particular outcome on a given trial. Expression (6) was evaluated recursively over x for each value of n (≥ 2) to obtain the cdf given by

$$B(x) = \sum_{i=0}^{x} b(i).$$

B(x) was then compared with the equivalent normal cdf (corrected for continuity) to determine if $D_{max} \leq .00999$. For n = 4 the 0.01 accuracy level was achieved for the normal approximation, and $\alpha_4(S_4) = 2.50$ resulted in $\varepsilon_4 = 0.50$. Therefore, an $\varepsilon_4 \leq .50$ will result, from (4), in sufficient number of RV's n to include in (1) to attain an accuracy level of .01 or better (i.e., if ε_4 is specified <.50, then D_{max} <.01).

NON-STANDARD DISCRETE DISTRIBUTION ANALYSES/RESULTS

A total of 305 different discrete RV's symmetrically distributed over x=1,2,...,9 were considered. These were grouped into five general classes (H_1, H_2, H_3, H_4, H_5) of distributions based on relative size of the probabilities $p(x_i)$. The classes were: H_1 (10 cases), unimodal at middle value but decreasing smoothly (Figure 1); H_2 (5 cases), nearly identical probabilities (Figure 2); H_3 (20 cases), bimodal at extremes and decreasing smoothly toward middle values (Figure 3); H_4 (90 cases), bimodal at intermediate values with small probabilities at middle and extreme values (Figures 4 and 5); H_5 (180 cases), other distributions from H_1, H_2, H_3, H_4 such as a unimodal distribution with mode at the middle value and submodel peaks elsewhere (Figure 6).
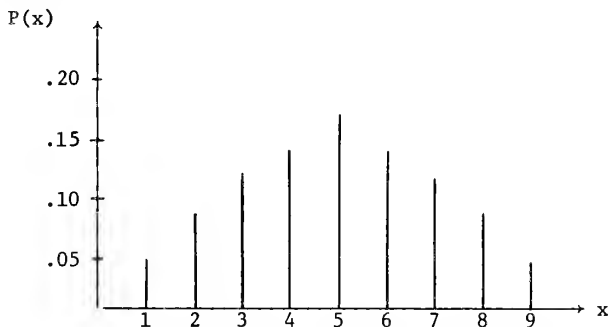

Figure 1. Unimodal and decreasing smoothly (H_1).
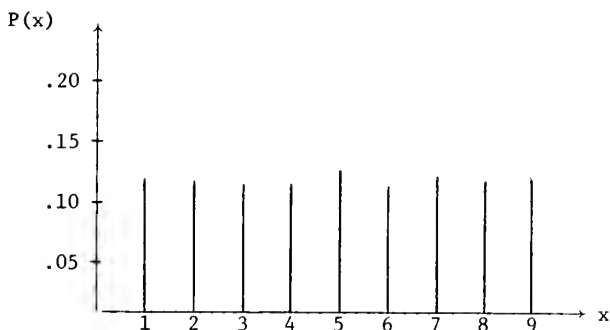
Figure 2.   Nearly   identical probabilities (H_2).
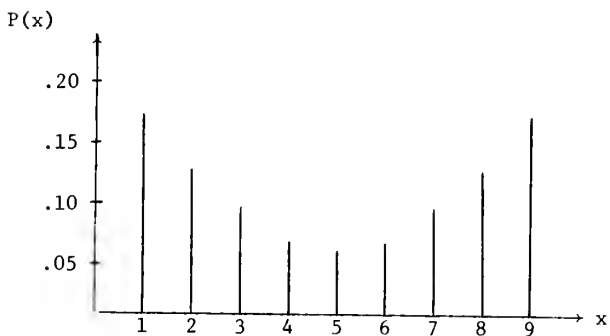
Figure 3.   Bimodal   at   extremes   and decreasing smoothly   toward   middle values (H_3).
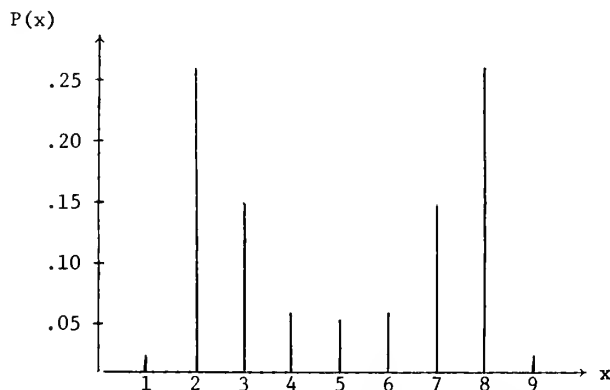
Figure 4.   Bimodal at intermediate values, small probabilities   at   middle and extreme values (H_4).
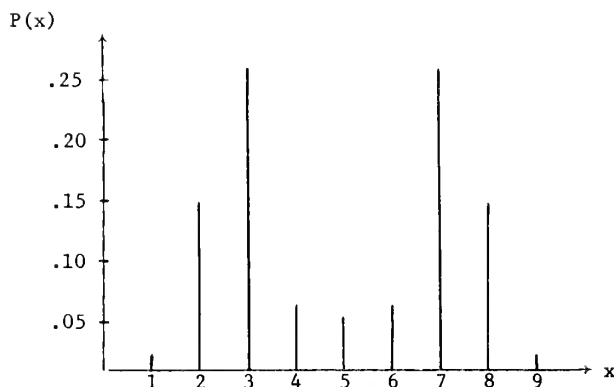
Figure 5. Bimodal at intermediate values, small
probabilities at middle and extreme
values (H_4).
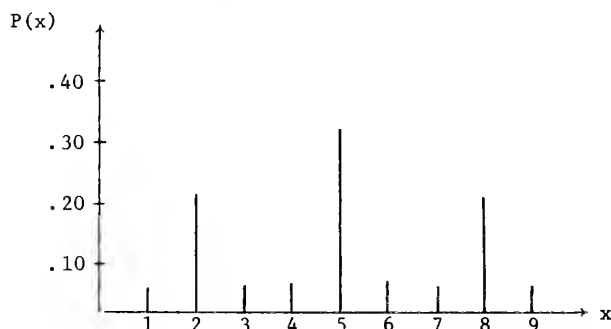
Figure 6. Unimodal with mode at middle values,
and sub-modal peaks elsewhere (H_5).

Table 1 lists the corresponding probabilities for examples H_1, H_2,
H_3, H_4, and H_5.

Table 1. Examples of Pd's of Non-Standard Discrete RV Empirical
Distributions Studied

x	H_1	H_2	H_3	H_4	H_5
1	.05	.11	.17	.005	.04
2	.09	.11	.13	.26	.21
3	.12	.11	.10	.15	.04
4	.15	.11	.07	.06	.05
5	.18	.12	.06	.05	.32
6	.15	.11	.07	.06	.05
7	.12	.11	.10	.15	.04
8	.09	.11	.13	.26	.21
9	.05	.11	.17	.005	.04

For each of the 305 distributions, the n-fold convolution of x was developed recursively using

$$f\ (S_n) = f(S_{n-1}) * f(x)$$

where $f(x)$ is the frequency function of each X in (1) and * denotes convolution. As an example, the frequency function $f(S_2)$ is shown below using H_4 of Table 1

s_2	$f(s_2)$
2	0.000025
3	0.0026
4	0.0691
5	0.0786
6	0.0542
7	0.0446
8	0.0513
9	0.1046
10	0.18995
11	0.1046
12	0.0513
13	0.0446
14	0.0542
15	0.0786
16	0.0691
17	0.0026
18	0.000025
elsewhere	0

The calculation of $P(S_2 = 3)$ is illustrated below

$$P(S_2 = 3) = p(X_1=1) \cdot P(X_2=2) + P(X_1=2) \cdot P(X_2=1)$$

$$= 0.0026.$$

The n-fold convolution was then used to obtain the cdf of S_n which was then compared with the equivalent normal cdf to determine if D_{max} $\leq$ .00999 (correction for continuity was applied in all cases).

Table 2 shows results for 13 of the 305 distributions considered for which ε_4 < .15 (twelve cases correspond to H_5).

6

Table 2

Results for Some Non-Standard Distributions
where $\varepsilon_4 < 0.15$

H_i	x_i: 1	2	3	4	5 $P(x)$	6	7	8	9	σ^2	μ_4	$\alpha_4(x)$	n_{min}	D_{max}	ε_4
4	.01	.01	.38	.01	.18	.01	.38	.01	.01	3.5600	18.9200	1.49287	15	.0099D-2	.1077
5	.395	.01	.01	.08	.01	.08	.01	.01	.395	13.0600	204.3400	1.19803	14	.8172D-2	.1386
5	.06	.01	.33	.01	.18	.01	.33	.01	.06	4.7600	42.9200	1.89429	14	.9266D-2	.0851
5	.31	.01	.01	.01	.32	.01	.01	.01	.31	10.2000	160.6800	1.54441	20	.9154D-2	.0766
5	.26	.01	.06	.01	.32	.01	.06	.01	.26	9.0000	136.6800	1.68741	13	.8756D-2	.1094
5	.01	.31	.01	.01	.32	.01	.01	.31	.01	6.0000	55.6800	1.54667	17	.9974D-2	.0908
5	.16	.01	.16	.01	.32	.01	.16	.01	.16	6.6000	88.6800	2.03581	12	.9955D-2	.0877
5	.11	.01	.21	.01	.32	.01	.21	.01	.11	5.4000	64.6800	2.21811	13	.9422D-2	.0652
5	.395	.01	.01	.01	.15	.01	.01	.01	.395	12.9200	204.2000	1.22329	19	.9455D-2	.0987
5	.005	.40	.01	.01	.15	.01	.01	.40	.005	7.4600	67.7000	1.21650	19	.9460D-2	.0991
5	.01	.01	.31	.01	.32	.01	.31	.01	.01	3.0000	16.6800	1.85333	16	.9240D-2	.0764
5	.01	.38	.01	.01	.18	.01	.01	.38	.01	7.2600	67.0200	1.27154	17	.9548D-2	.1080
5	.16	.01	.23	.01	.18	.01	.23	.01	.16	7.1600	90.9200	1.77351	13	.8883D-2	.1022

Table 3 shows results for 25 of the distributions considered for which $\varepsilon_4 > .15$ (this table is composed of representatives of each type of non-standard distribution considered).

The smallest ε_4 from the 305 distributions was $\varepsilon_4 = 0.06516$, but 292 of the 305 (95.74%) had $\varepsilon_4 \geq .15$.

UNIFORM DISTRIBUTION ANALYSES/RESULTS

The uniform distribution considered in (1) had the specific pdf

$$f(x) = \begin{cases} 1, & -\tfrac{1}{2} \leq x \leq \tfrac{1}{2} \\ 0, & \text{elsewhere} \end{cases} \quad . \tag{7}$$

The above pdf was successively convoluted until the resulting cdf of S_n was within 0.01 of the equivalent normal cdf.

The n-fold convolution of (7) was first obtained mathematically [5] for n = 2 as $f(S_2) = \int_{R_x} f(x)f(S_2 - x)dx$, where R_x denotes the range of x, giving

$$f(S_2) = \begin{cases} 1 + S_2, & -1 \leq S_2 \leq 0, \\ 1 - S_2, & 0 \leq S_2 \leq 1, \\ 0, & \text{elsewhere} \end{cases} \tag{8}$$

which is triangular over $[-1, 1]$. Expression (8) was then integrated (via computer) to obtain che cdf of S_2 which was then compared with the equivalent normal cdf. For S_2, $D_{max} = .01641$, therefore the 0.01 accuracy level was not achieved.

The 3-, 4-, 5-, 6- and 8-fold convolutions of (7) were next derived and are given in equations (9) thru (13).

$$f_{S_3}(y) = f(x) * f(S_2) = \begin{cases} y^2/2 + 3y/2 + 9/8, & -3/2 \leq y \leq -1/2, \\ -y^2 + 3/4, & -1/2 \leq y \leq 1/2, \\ y^2/2 - 3y/2 + 9/8, & 1/2 \leq y \leq 3/2, \\ 0, & \text{elsewhere.} \end{cases} \tag{9}$$

$$f_{S_4}(y) = f(S_2) * f(S_2) = \begin{cases} y^3/6 + y^2 + 2y + 4/3, & -2 \leq y \leq -1, \\ -y^3/2 - y^2 + 2/3, & -1 \leq y \leq 0, \\ y^3/2 - y^2 + 2/3, & 0 \leq y \leq 1, \\ -y^3/6 + y^2 - 2y + 4/3, & 1 \leq y \leq 2, \\ 0, & \text{elsewhere.} \end{cases} \tag{10}$$

8

Table 3

Results for Some Non-Standard Distributions
where $\varepsilon_4 > .15$

Class (H_i)	x_1: 1	2	3	4	5 $P(x)$	6	7	8	9	$V(x)$	$a_4(x)$	n_{min}	D_{max}	ε_4
1	.04	.08	.12	.16	.20	.16	.12	.08	.04	4.00	2.35000	2	.6820D-2	.3250
1	.05	.09	.12	.15	.18	.15	.12	.09	.05	4.48	2.20823	2	.9195D-2	.3959
1	.03	.07	.11	.15	.28	.15	.11	.07	.03	3.40	2.64014	2	.3527D-2	.1799
2	.11	.11	.11	.11	.12	.11	.11	.11	.11	6.60	1.78788	3	.9401D-2	.4040
2	.10	.12	.10	.12	.12	.12	.10	.12	.10	6.40	1.80859	3	.9302D-2	.3971
2	.12	.10	.12	.10	.12	.10	.12	.10	.12	6.80	1.76644	3	.9684D-1	.4111
2	.09	.13	.09	.13	.12	.13	.09	.13	.09	6.20	1.82830	3	.9221D-2	.3906
3	.13	.09	.13	.09	.12	.09	.13	.09	.13	7.00	1.74449	4	.7362D-2	.3139
3	.17	.13	.10	.07	.06	.07	.10	.13	.17	8.72	1.46558	5	.6240D-2	.3069
3	.22	.11	.09	.06	.04	.06	.09	.11	.22	9.86	1.37277	5	.8051D-2	.3254
3	.27	.10	.07	.05	.02	.05	.07	.10	.27	11.10	1.27246	7	.7245D-2	.2468
3	.305	.09	.06	.04	.01	.04	.06	.09	.305	11.94	1.21167	7	.9605D-2	.2555
3	.245	.12	.08	.05	.01	.05	.08	.12	.245	10.74	1.27909	7	.7349D-2	.2458
4	.005	.15	.26	.06	.05	.06	.26	.15	.005	5.06	1.37871	6	.9205D-2	.2702
4	.005	.26	.15	.06	.05	.06	.15	.26	.005	6.16	1.30713	6	.9841D-2	.2821
4	.02	.30	.14	.03	.02	.03	.14	.30	.02	7.22	1.21584	9	.7235D-2	.1982
4	.02	.14	.30	.03	.02	.03	.30	.14	.02	5.62	1.34813	7	.8118D-2	.2360
4	.04	.24	.13	.07	.04	.07	.13	.24	.04	6.78	1.38486	5	.8942D-2	.3230
5	.04	.13	.24	.07	.04	.07	.24	.13	.04	5.68	1.52995	5	.6983D-2	.2940
5	.105	.01	.30	.06	.05	.06	.30	.01	.105	6.06	1.77270	7	.7978D-2	.2046
5	.055	.01	.35	.06	.05	.06	.35	.01	.055	4.86	1.74008	8	.6425D-2	.1800
5	.31	.08	.01	.01	.18	.01	.01	.08	.31	11.46	1.30981	10	.8231D-2	.1877
5	.26	.01	.06	.16	.02	.16	.06	.01	.26	9.30	1.58377	8	.8174D-2	.2027
5	.055	.35	.01	.01	.15	.01	.01	.35	.055	8.16	1.27956	10	.9025D-2	.1911
5	.255	.06	.10	.01	.15	.01	.10	.06	.255	10.06	1.41793	7	.9195D-2	.2636

$$f_{S_5}(y) = f(x) \star f(S_4) = \begin{cases} y^4/24 + 5y^3/12 + 25y^2/16 + 125y/48 + 625/384, & -5/2 \le y \le -3/2, \\[4pt] -y^4/6 - 5y^3/6 - 5y^2/4 - 5y/24 + 55/96, & -3/2 \le y \le -1/2, \\[4pt] y^4/4 - 5y^2/8 + 115/192, & -1/2 \le y \le 1/2, \\[4pt] -y^4/6 + 5y^3/6 - 5y^2/4 + 5y/24 + 55/96, & 1/2 \le y \le 3/2, \\[4pt] y^4/24 - 5y^3/12 + 25y^2/16 - 125y/48 + 625/384, & 3/2 \le y \le 5/2. \end{cases} \quad (11)$$

$$f_{S_6}(y) = f(S_2) \star f(S_4) = \begin{cases} y^5/120 + y^4/8 + 3y^3/4 + 9y^2/4 + 27y/8 + 81/40, & -3 \le y \le -2, \\[4pt] -y^5/24 - 3y^4/8 - 5y^3/4 - 7y^2/4 - 5y/8 + 17/40, & -2 \le y \le -1, \\[4pt] y^5/12 + y^4/4 - y^2/2 + 11/20, & -1 \le y \le 0, \\[4pt] -y^5/12 + y^4/4 - y^2/2 + 11/20, & 0 \le y \le 1, \\[4pt] y^5/24 - 3y^4/8 + 5y^3/4 - 7y^2/4 + 5y/8 + 17/40, & 1 \le y \le 2, \\[4pt] -y^5/120 + y^4/8 - 3y^3/4 + 9y^2/4 - 27y/8 + 81/40, & 2 \le y \le 3. \end{cases} \quad (12)$$

$$f(S_8) = f(S_4) \star f(S_4) =$$

$$= \begin{cases} \dfrac{s_8^7}{5040} + \dfrac{s_8^6}{180} + \dfrac{s_8^5}{15} + \dfrac{4s_8^4}{9} + \dfrac{16s_8^3}{9} + \dfrac{64s_8^2}{15} + \dfrac{256s_8}{45} + \dfrac{1024}{315}, & -4 \le s_8 \le -3, \\[10pt] -\dfrac{s_8^7}{720} + \dfrac{s_8^6}{36} + \dfrac{7s_8^5}{30} + \dfrac{19s_8^4}{18} + \dfrac{49s_8^3}{18} + \dfrac{23s_8^2}{6} + \dfrac{217s_8}{90} + \dfrac{139}{630}, & -3 \le s_8 \le -2, \\[10pt] \dfrac{s_8^7}{240} + \dfrac{s_8^6}{20} + \dfrac{7s_8^5}{30} + \dfrac{s_8^4}{2} + \dfrac{7s_8^3}{18} + \dfrac{s_8^2}{10} + \dfrac{7s_8}{90} + \dfrac{103}{210}, & -2 \le s_8 \le -1, \\[10pt] -\dfrac{s_8^7}{144} + \dfrac{s_8^6}{36} + \dfrac{s_8^4}{9} + \dfrac{s_8^2}{3} + \dfrac{151}{315}, & -1 \le s_8 \le 0, \\[10pt] \dfrac{s_8^7}{144} - \dfrac{s_8^6}{36} - \dfrac{s_8^4}{9} - \dfrac{s_8^2}{3} - \dfrac{151}{315}, & 0 \le s_8 \le 1, \\[10pt] -\dfrac{s_8^7}{240} + \dfrac{s_8^6}{20} + \dfrac{7s_8^5}{30} + \dfrac{s_8^4}{2} + \dfrac{7s_8^3}{18} + \dfrac{s_8^2}{10} + \dfrac{7s_8}{90} + \dfrac{103}{210}, & 1 \le s_8 \le 2, \\[10pt] \dfrac{s_8^7}{720} + \dfrac{s_8^6}{36} + \dfrac{7s_8^5}{30} + \dfrac{19s_8^4}{18} + \dfrac{49s_8^3}{18} + \dfrac{23s_8^2}{6} + \dfrac{217s_8}{90} + \dfrac{139}{630}, & 2 \le s_8 \le 3, \\[10pt] -\dfrac{s_8^7}{5040} + \dfrac{s_8^6}{180} + \dfrac{s_8^5}{15} + \dfrac{4s_8^4}{9} + \dfrac{16s_8^3}{9} + \dfrac{64s_8^2}{15} + \dfrac{256s_8}{45} + \dfrac{1024}{315}, & 3 \le s_8 \le 4, \\[10pt] 0, & \text{elsewhere.} \end{cases} \quad (13)$$

The values of D_{max} for $f(S_n)$, $n = 3, 4, 5, 6$ and 8 were found to be .009750, .007283, .005711, .00474 and .003533, respectively. Although the .01 accuracy level was barely achieved at $n = 3$ and definitely for $n \geq 4$, the quantiles of the END, denoted by $N_{n;1-\alpha}$, did not adequately approximate the corresponding quantiles, $S_{n;1-\alpha}$, of $f(S_n)$, $n = 3, 4, 5,$ and 6, where by $S_{n;1-\alpha}$ we mean $P(S_n \leq S_{n;1-\alpha}) = 1-\alpha$, $n = 2, 3, 4,\ldots\ldots$ For example, using equation (10) and the fact that $\sigma_4 = \sqrt{n/12} = \sqrt{1/3} = .57735$, simple computations yield $S_{4;.79948} = 1/2$, $N_{4;.79948} = .48474$ and $S_{4;.99740} = 1.50$ while $N_{4;.99740} = 1.61325$. Similarly, $S_{6;.75551} = 1/2$ while $N_{6;.75551} = .48910$ with $\sigma_6 = \sqrt{6/12} = .70711$. Furthermore, the function $N(0, 2/3)$ does not adequately approximate $f(S_8)$ at the extreme quantiles ($\alpha < .025$ or $\alpha > .975$); e.g., $S_{8;.006151} = -2.0$ whereas $N_{8;.006151} = -2.0443$. However, the agreement between the quantiles of $f(S_8)$ and $N(0, 2/3)$ is better than .01 over the interval $[.025, .975]$.

From the above discussion, we conclude that a linear sum of four independent uniform RV's from (7) is adequately approximated by the $N(0, 1/3)$ at the .01 accuracy level (i.e., the Kolmogorov Statistic < .01). This is in good agreement with a well-known fact that the distribution of sample means of size $n = 4$ from a uniform distribution over the real interval (a, b) is well approximated by a normal density with mean $(a + b)/2$ and variance $(b - a)^2/12$. However, the quantiles are not adequately approximated over the entire range (na, nb) of S_n unless $n > 8$.

DOUBLE EXPONENTIAL DISTRIBUTION ANALYSES/RESULTS

The pdf of the double exponential distribution is

$$f(x) = \begin{cases} (\lambda/2)e^{\lambda x}, & -\infty < x \leq 0, \\ (\lambda/2)e^{-\lambda x}, & 0 \leq x < \infty. \end{cases} \qquad (14)$$

where $\lambda > 0$. The density function in (14) was used to obtain $f(S_2) = (\lambda/4)(1 + \lambda|S_2|)e^{-\lambda|S_2|}$, $-\infty < S_2 < \infty$ which did not achieve the 0.01 accuracy level for any $\lambda > 0$ ($D_{max} = 0.1750$). The 4- and 6-fold convolutions are given below:

$$f_{S_4}(y) = f(S_2) * f(S_2) = \begin{cases} (\lambda/64)(10 - 10y + 4\lambda^2 y^2 - 2/3\lambda^3 y^3)e^{\lambda y} \\ \qquad -\infty < y \leq 0, \\ (\lambda/64)(10 + 10y + 4\lambda^2 y^2 + 2/3\lambda^3 y^3)e^{-\lambda y} \\ \qquad 0 \leq y < \infty. \end{cases}$$

$$\bar{f}_{S_6}(y) = f(S_2) * f(S_4) = \begin{cases} (\lambda/7680)\left[-\lambda^5 y^5 + 15\lambda^4 y^4 - 105\lambda^3 y^3 + 420\lambda^2 y^2 - \right. \\ \qquad\qquad\qquad \left. -945\lambda y + 945\right] e^{\lambda y}, \ -\infty < y \le 0 \ , \\ (\lambda/7680)\left[\lambda^5 y^5 + 15\lambda^4 y^4 + 105\lambda^3 y^3 + 420\lambda^2 y^2 + \right. \\ \qquad\qquad\qquad \left. + 945\, y + 945\right] e^{-\lambda y} \ , \ 0 \le y < \infty \ . \end{cases}$$

The values of D_{max} for the above 4- and 6-fold convolutions were .09400 and .04422, respectively, and thus the .01 accuracy level was not achieved.

Since the computations involved in obtaining the 6-fold convolution were so tedious and time-consuming (8 manhours) and the fact that the $D_{max} = .04422$ was far away from the desired .01 value, the 7-fold convolution was bypassed in favor of 8-fold convolution. Our conjecture is that the 7-fold convolution would not achieve the 0.01 accuracy level. The 8-fold convolution was then derived as

$$f(S_8) = f(S_4) * f(S_4) = \begin{cases} (\lambda/4096)\left[429 - 429\lambda s_8 + 198\lambda^2 s_8^2 - 55\lambda^3 s_8^3 \right. \\ \qquad + 10\lambda^4 s_8^4 - 1.2\lambda^5 s_8^5 + 4\lambda^6 s_8^6/45 - \\ \qquad \left. \lambda^7 s_8^7/315\right] e^{\lambda s_8}, \ -\infty < s_8 \le 0, \\ (\lambda/4096)\left[429 + 429\lambda s_8 + 198\lambda^2 s_8^2 + 55\lambda^3 s_8^3 \right. \\ \qquad + 10\lambda^4 s_8^4 + 1.2\lambda^5 s_8^5 + 4\lambda^6 s_8^6/45 + \\ \qquad \left. \lambda^7 s_8^7/315\right] e^{-\lambda s_8}, \ 0 \le s_8 < \infty \ . \end{cases} \qquad (15)$$

The cdf of S_8 was obtained (via computer) by integrating (15) for selected values of S_8 over the arbitrarily selected range $-10 \le S_8 \le 10$ in increments of 0.25; λ values considered were from 0.1 to 1.0 in increments of 0.1, and from 1.0 to 5.5 in increments of 0.5. The cdf of S_8 for each λ value was then compared with the equivalent normal cdf, and for all cases considered $D_{max} < 0.00999$ (the largest value of D_{max} was 0.008605 when $\lambda = .1, .4, .7, .8$). The standardized fourth moment of S_8 was computed to be $\alpha_4(S_8) = 3.375$ (note that it is independent of λ), therefore $\varepsilon_4 = 0.375$ for all λ.

SUMMARY OF RESULTS AND CONCLUSIONS

For the binomial distribution, S_n is approximated at the 0.01 accuracy level when $n = 4$ resulting in $\varepsilon_4 = 0.50$. For 292 of 305 (95.74%) non-standard discrete distributions the approximation is adequate with the resulting $\varepsilon_4 > 0.15$, the remaining 13 distributions producing $0.06516 \le \varepsilon_4 < 0.15$. When S_n was composed of $n = 4$ inde-

pendent uniformly distributed random variables from (7), it was approximated by the normal distribution at the 0.01 accuracy level resulting in $\varepsilon_4 = 0.15$. However, more than eight uniform RV's must be included in (1) before the quantiles of S_n are well approximated by those of $N(0, n/12)$ over the entire range of S_n given by $(-n/2, n/2)$. Finally, for the double exponential distribution of (14) the normal approximation was adequate at the 0.01 accuracy level when $n = 8$ resulting in $\varepsilon_4 = 0.375$.

Based on the ε_4 values obtained for the cases considered, it is concluded that a conservative $\varepsilon_4 = 0.15$ is sufficiently small to allow a simple LC of n independent, identical and symmetrical RV's to be normally approximated at 0.01 accuracy level. In many instances $\varepsilon_4 = 0.15$ will provide an accuracy even better than 0.01, while in only a very small proportion of cases will a less accurate normal approximation be achieved. Furthermore, the results obtained herein are also applicable to simple LC's of independent RV's of the type $S_n' = cX_1 + cX_2 + ... + cX_n$ for any constant c (such as c=1/n) since $\alpha_4(S_n') = \alpha_4(S_n)$ as given in equation (2a).

LITERATURE CITED

[1] Conover, W. J., *Practical Nonparametric Statistics*, John Wiley, New York, pg. 293-295, (1971).

[2] Hines, W. W. and Montgomery, D. C., *Probability and Statistics in Engineering and Management Science*, 2nd edition, John Wiley, New York, pg. 181-185, (1980).

[3] Hoel, P. G., *Introduction to Mathematical Statistics*, 3rd edition, John Wiley, New York, pg. 109-110, (1974).

[4] Hool, J. N. and Maghsoodloo, S., "Normal Approximation to Linear Combinations of Independently Distributed Random Variables", AIIE Transactions, Vol. 12, No. 2, pg. 140-144, (June 1980).

[5] Meyer, P. L., *Introductory Probability and Statistical Applications*, 2nd edition, Addison-Wesley, Reading, Massachusetts, pg. 257, (1970).

NEW FEDERALISM AND THE ALABAMA MULE[1]

David L. Martin
Department of Political Science
Auburn University, AL   36849

"Starting in fiscal 1984, the Federal Government will assume full responsibility for the cost of the rapidly growing Medicaid program to go along with its existing responsibility for Medicare. As part of a financially equal swap, the states will simultaneously take full responsibility for Aid to Families with Dependent Children and food stamps. This will make welfare less costly and more responsive to genuine need because it will be designed and administered closer to the grass roots and the people it serves.

In 1984, the Federal Government will apply the full proceeds from certain excise taxes to a grass-roots trust fund that will belong, in fair shares, to the 50 states. The total amount flowing into this fund will be $28 billion a year.

Over the next four years, the states can use this money in either of two ways. If they want to continue receiving Federal grants in such areas as transportation, education and social services, they can use their trust fund money to pay for the grants or, to the extent they choose to forego the Federal grant programs, they can use their trust fund money on their own, for those or other purposes. There will be a mandatory pass-through of part of these funds to local government.

By 1988, the states will be in complete control of over 40 Federal grant programs. The trust fund will start to phase out, eventually to disappear, and the excise taxes will be turned over to the states. They can then preserve, lower or raise taxes on their own and fund and manage these programs as they see fit."

> President Reagan's Message on
> The State of the Union
> January 27, 1982

Let us examine the Alabama mule in the mouth to see if New Federalism will be a gift horse or a less desirable part.

In order of the President's Message, the first program is Medicaid. Alabama pays the smallest Medicaid benefits allowed under existing federal rules. Alabama provides only 12 types of optional medical services above that required by the federal basic rule, compared to as many as 30 options in other states.[1] Thus Alabama is atypical of other states in that its Medicaid costs are less than public assistance would be (if food stamps and AFDC are turned over to the states). Also, Alabama has no program for the "medically needy" defined as those not poor enough for welfare, but too poor to pay medical bills. If Medicaid becomes totally federalized, Congress will probably find it politically impossible to provide different levels of medical services in different states, so Alabamians would probably benefit from a higher uniform national standard than they currently receive.

It costs Alabama approximately $14 million to administer the food stamp program, and the state contributes $32 million annually to Aid to Families with Dependent Children (AFDC). Currently, Alabama due to its poverty, enjoys one of the most favorable state contribution ratios, with the Federal Government paying most of the program costs. Moreover, Alabama in the past has saved on cash welfare payments (indeed having no state general assistance program) since food stamps financed by Washington were indexed to a rising poverty line. In this part of the swap, it appears that Alabama will be assuming increasing costs just to maintain the poor at subsistence levels (The maximum Alabama AFDC benefit for one adult and three children is $148 /month.[2])

The swap will also bring some explosive political issues to the Alabama Legislature. For example, about 80% of the welfare recipients in Alabama are black families.[3] Given the sad statistic that in 1979 over 50% of all black babies born in this state were illegitimate,[4] AFDC payments will be high. Imagine the political controversy that could erupt in this state over the issue of state financed abortions for welfare recipients.

In the second phase of the "New Federalism" a new federal trust fund will be set up beginning FY 1984 to finance over 40 programs being turned over to the states (see Chart I). The Federal Government would set aside existing excise taxes on alcohol, tobacco, and telephone service, plus half the revenue from the federal gasoline tax (now 4¢ a gallon). Some proceeds of the windfall profits tax on oil would also go into the trust fund, which is projected to yield $28 billion annually.

From fiscal years 1988 to 1991, federal excise taxes would be reduced by 25% a year. States would be free to impose similar taxes of their own if they wanted to continue financing programs given up by the Federal Government.[5]

CHART I: LIST OF PROGRAMS TO BE TURNED BACK

Many of these programs were already consolidated into block grants in 1981, but the Administration counts them as over 40, since some are divided into subgroups.

Labor:
                1. Vocational rehabilitation
                2. Vocational and adult education
                3. State block grants
                4. Comprehensive and Employment Training Act
                5. Work incentive program

Community Development:
                6. Water and sewer
                7. Community facilities loans
                8. Community development block grants
                9. Urban development action grants
                10. Waste water treatment plants

Transportation:
                11. Grants-in-aid for airports
                12. Highways (not including interstate)
                13. Interstate transfer
                14. Appalachian highways
                15. Urban mass transit construction
                16. Urban mass transit operating expenses

Welfare:
                17. Low-income energy assistance
                18. Child nutrition
                19. Child welfare
                20. Adoption assistance
                21. Foster care
                22. Runaway youth
                23. Child abuse
                24. Social services block grants
                25. Legal services
                26. Community services block grants
                27. Prevention block grants
                28. Alcohol, drug abuse, and mental health block grants
                29. Primary care block grants
                30. Maternal and child health block grants
                31. Primary care research and development
                32. Black lung clinics
                33. Migrant health clinics
                34. Family planning
                35. Women, infants, and children (W.I.C.) program

Revenue Sharing:
                36. Occupational safety and health grants
                37. General revenue sharing

From 1984 to 1987 then, states could either withdraw from or continue to participate in the programs, subject to federal rules. If they stayed in the programs, they would have to use the trust fund money they received to reimburse the Federal Government for program expenses. By 1988, these programs would no longer be federal, but be turned over to the states. Such programs would be run entirely by the states and financed with payments from the trust fund, which expires in 1991.[6]

Chart II reproduces the Administration's January projection of how the money will flow, and Chart III the National Governors' Association March estimate of the effects on states of reductions in federal grants. (Note that the White House FY 84 figures are "for illustrative purposes only," while the Governors' figures are for FY 83 and assume a 7% inflation rate.) Thus, the federal OMB projects the Medicaid swap for food stamps and AFDC will cost Alabama $210 million, while the James Administration figures $270 million.[7]

CHART II - NEW FEDERALISM: HOW THE MONEY WILL FLOW

TURNBACK PROGRAM

	Trust Fund Allocation	Turnback Programs	Net Difference
Ala.	$ 713	$ 503	$ 210
Alaska	188	166	22
Ariz.	463	306	157
Ark.	345	308	37
Calif.	2,144	2,638	-494
Colo.	331	358	-27
Conn.	283	390	-108
Del.	107	106	2
D.C.	333	390	-57
Fla.	1,433	1,152	281
Ga.	819	674	146
Hawaii	145	133	12
Idaho	151	131	20
Ill.	1,547	1,565	-18
Ind.	552	612	-61
Iowa	330	3,356	-26
Kan.	225	272	-47
Ky.	690	509	181
La.	634	564	70
Me.	240	219	21
Md.	507	566	-59
Mass.	732	983	-251
Mich.	1,147	1,186	-39
Minn.	236	535	-299
Miss.	563	379	184
Mo.	700	652	48
Mont.	128	132	-4
Neb.	185	202	-17
Nev.	58	97	-39
N.H.	110	126	-16

CHART II, cont'd

	Trust Fund Allocation	Turnback Programs	Net Difference
N.J.	907	1,038	-132
N.M.	251	188	64
N.Y.	789	3,118	-2,329
N.C.	820	722	97
N.D.	83	107	-24
Ohio	1,406	1,335	71
Okla.	249	332	-82
Ore.	393	356	38
Pa.	1,658	1,750	-92
R.I.	124	141	-17
S.C.	553	399	154
S.D.	124	123	1
Tenn.	702	567	135
Tex.	1,352	1,458	-106
Utah	182	183	0
Vt.	118	97	21
Va.	617	579	39
Wash.	493	502	-8
W.Va.	429	338	91
Wis.	235	572	-337
Wyo.	75	77	-2
TOTAL	$27,600	$30,194	-$2,594

Source: The White House, FY 1984 estimates

SWAP PROGRAM

	Medicaid Savings	Public Assistance Cost	Net Difference	Overall Total of Both Programs
Ala.	$ 140	$ 350	$ -210	$ 853
Alaska	32	53	-22	220
Ariz.	0	157	-157	462
Ark.	137	174	-37	482
Calif.	2,524	2,030	494	4,668
Colo.	161	134	27	492
Conn.	277	169	108	560
Del.	38	40	-2	146
D.C.	141	84	57	474
Fla.	348	628	-281	1,781
Ga.	285	431	-146	1,104
Hawaii	94	106	-12	239
Idaho	31	51	-20	182
Ill.	857	838	18	2,402
Ind.	336	275	61	887
Iowa	166	140	26	496
Kan.	141	94	47	366
Ky.	186	367	-181	875

SWAP PROGRAM, Continued

	Medicaid Savings	Public Assistance Cost	Net Difference	Overall Total of Both Programs
La.	309	379	−70	943
Me.	81	102	−21	321
Md.	342	283	59	849
Mass.	669	418	251	1,401
Mich.	914	874	39	2,061
Minn.	501	202	299	737
Miss.	109	293	−184	671
Mo.	247	296	−48	947
Mont.	43	39	4	171
Neb.	77	60	17	262
Nev.	70	30	39	127
N.H.	57	40	16	166
N.J.	557	426	132	1,464
N.M.	57	120	−64	308
N.Y.	4,002	1,673	2,329	4,791
N.C.	277	375	−97	1,097
N.D.	45	20	24	127
Ohio	744	815	−71	2,150
Okla.	228	146	82	478
Ore.	128	165	−38	521
Pa.	967	875	92	2,625
R.I.	95	78	17	219
S.C.	128	282	−154	682
S.D.	32	33	−1	155
Tenn.	267	401	−135	969
Tex.	833	726	106	2,184
Utah	61	60	0	243
Vt.	32	53	−21	150
Va.	250	228	−39	867
Wash.	248	240	8	742
W.Va.	65	156	−91	494
Wis.	633	296	337	868
Wyo.	17	14	2	91
TOTAL	$18,976	$16,382	$2,594	$46,576

CHART III - THE NATIONAL GOVERNORS' ASSOCIATION:
EFFECT ON STATES OF REDUCTIONS IN FEDERAL GRANTS

	Amount Needed	Amount Proposed	Difference (Actual)	--Difference-- As Pct. Of Amount Needed	Per Capita
	--(In millions of dollars)--				
Ala.	$ 1,498	$ 1,205	$ -283	19.0%	-$ 73
Alaska	458	378	-80	17.6	-202
Ariz.	788	628	-160	20.3	-59
Ark.	900	756	-144	16.0	-63
Calif.	10,434	8,594	-1,840	17.6	-78
Colo.	1,031	856	-175	17.0	-61
Conn.	1,238	1,022	-216	17.4	-69
Del.	267	221	-46	17.1	-77
Fla.	3,158	2,574	-584	18.5	-60
Ga.	2,427	2,017	-410	16.9	-75
Hawaii	497	411	-86	17.2	-89
Idaho	376	311	-65	17.2	-68
Ill.	4,371	3,538	-833	19.1	-73
Ind.	1,785	1,463	-322	18.1	-63
Iowa	1,032	849	-183	17.8	-57
Kan.	783	650	-133	17.1	-63
Ky.	1,535	1,268	-267	17.4	-73
La.	1,846	1,553	-293	15.9	-70
Me.	564	465	-99	17.4	-87
Md.	1,869	1,541	-328	17.5	-78
Mass.	2,996	2,477	-519	17.3	-90
Mich.	3,986	3,210	-776	19.5	-84
Minn.	1,857	1,541	-316	17.0	-77
Miss.	1,170	982	-188	16.1	-75
Mo.	1,811	1,483	-328	18.1	-67
Mont.	433	365	-68	15.8	-87
Neb.	549	462	-97	17.6	-62
Nev.	330	281	-49	14.8	-61
N.H.	350	289	-61	17.5	-67
N.J.	2,943	2,402	-541	18.4	-74
N.M.	837	760	-77	9.2	-59
N.Y.	10,622	8,856	-1,766	16.6	-101
N.C.	2,024	1,681	-343	17.0	-58
N.D.	331	277	-54	16.4	-83
Ohio	3,946	3,212	-734	18.6	-68
Okla.	1,078	897	-181	16.8	-60
Ore.	1,057	910	-147	13.9	-56
Pa.	5,002	4,103	-899	18.0	-76
R.I.	526	440	-86	16.5	-92
S.C.	1,136	943	-193	17.0	-62
S.D.	350	288	-62	17.8	-90
Tenn.	1,894	1,504	-390	20.6	-85
Tex.	4,272	3,554	-718	16.8	-50
Utah	618	519	-99	16.0	-68
Vt.	305	252	-53	17.4	-104

CHART III, Continued

	Amount Needed	Amount Proposed	Difference (Actual)	--Difference-- As Pct. Of Amount Needed	Per Capita
	--(In millions of dollars)--				
Va.	$ 1,794	$ 1,481	$ -313	17.5%	$-59
Wash.	1,619	1,327	-292	18.0	-71
W.Va.	871	720	-151	17.4	-78
Wis.	2,325	1,924	-401	17.2	-85
Wyo.	438	445	7	1.4	13
AREAS OTHER THAN STATES					
	3,295	3,545	+250	7.6	+60
TOTAL	97,605	81,418	-16,187	16.6	-70

SOURCE: Estimates derived from report by the National Governor's Association for FY 1983 of 41 Federal grant-in-aid programs to states.

Not at issue is the fact that heretofore, the State of Alabama has been a net beneficiary of federal grants. In the late 1970s, southeastern states received back $1.14 for every tax dollar sent to the Federal Government. If every state received an equal per capita share of Federal expenditures, southeastern states would have a ratio of $1.15 instead of $1.14.[8] The President's Message simply says the federalism trust fund monies will be distributed "in fair shares to the 50 states."[9]

Consider the Alabama experience with the types of taxes proposed for return to the states betwen 1988 and 1991. Alabama already imposes excise taxes on alcohol, tobacco, and gasoline, as well as a state severance tax on oil and gas production. In the case of alcohol and tobacco, Alabama has to contend with bootlegging from other states, and might have to increase its enforcement efforts if price differential widened with varying state taxes under the New Federalism. Since alcohol, tobacco, and gasoline taxes have been levied by unit, price increases have not been revenue responsive. Under the New Federalism, Alabama could increase its state gasoline tax once again, but interstate highways would be among the turned back programs. Transfer of the federal telephone tax should add to the lively rate setting hearings before the Alabama Public Service Commission.

Alabama officials appear to be gambling that the state's relative position at the bottom will qualify it on the basis of need for whatever federal "safety net" remains. The major controversy that appears to be developing involves whether the states will have the political will to tax themselves once federal program support is withdrawn. The Alabama mule, after having become accustomed to Yankee provisions, is going to have to decide how to forage on its own under the New Federalism.

FOOTNOTES

1. Peggy Roberson, "Reagan's Plan Might Enrich State Medicaid," *The Montgomery Advertiser*, January 31, 1982, p. 1.

2. "Maximum Welfare Benefits: State by State Comparisons," *The New York Times*, November 2, 1981, p. 13.

3. Editorial "Swap? Or Swindle?" *The New York Times*, February 1, 1982, p. 14.

4. "Out of Wedlock Births by State," *The New York Times*, October 26, 1981, p. 13.

5. Robert Pear, "Questions on President's Proposals Sharing State and U.S. Programs," *The New York Times*, January 28, 1982, p. 10.

6. *Ibid.*

7. Roberson, *op cit*. This appears to be one reason why Governor James supports the New Federalism. In a personal interview February 17, 1982, Rebecca Beasley, State Budget Officer told the author that the swap loss would be offset by the 124 grants Alabama currently receives.

8. From a forthcoming article by Prof. Janet Rothenberg Pack of the University of Pennsylvania, "The States' Scramble for Federal Funds," *Journal of Policy Analysis and Management* (Harvard University).

9. The President's Message on the State of the Union, January 26, 1982.

FINE STRUCTURAL STUDY OF THE EFFECT OF SPECIES VARIATION ON THE
MODE OF CATECHOLAMINE RELEASE FROM THE ADRENAL MEDULLA[1]

Fadhil Al-Lami
Department of Biology
University of Montevallo
Montevallo, Alabama 35115

Abstract

    Rhesus monkeys (Macaca mulatta) and Syrian hamsters were intra-
peritoneally injected with light doses of reserpine (1.5 mg./kg. for
monkeys and 1 mg./kg. for hamsters) one hour after the administration
of the ganglion blocking agent mecamylamine (20 mg./kg. for monkeys
and 25 mg./kg. for hamsters), and their adrenal medullas were studied
at the fine structural level.   In the monkey, depleted medullary
cells displayed three types of vesicles: dark-colored (200 nm in
dia.) comparable in osmiophilic density to that of catecholamine (CA)
vesicles of control tissue; lighter but larger ones (averaging 600 nm
in dia.); and small electron-lucent vesicles (7-14 nm in dia.).
Those vesicles were distributed randomly throughout the cytoplasm
with no more affinity for the plasma membrane than in control tissue
and their total number approximated that of control cells.   In the
hamster, the remaining CA vesicles of depleted cells accumulated
along the plasma membrane and some were in contact with it and were
comparable in osmiophilic density to that of the control cells.
Small electron-lucent vesicles were also observed throughout the
cytoplasm but large, light vesicles were not seen here.   The mecha-
nisms of exocytosis and molecular diffusion were considered, and it
was concluded that in these two cases, species variation seemed to
influence the cytological alteration of adrenomedullary cells caused
by reserpine.

INTRODUCTION

    It is well documented that reserpine evokes the release of
catecholamines (CA) from the adrenal medulla (9), but the precise
mechanism by which the amines are released from the cell has not yet
been characterized.   Some believe it is dose dependent contending
that a light dose acts directly on the adrenomedullary vesicles
causing the release of CA by molecular diffusion through the cyto-
plasm, whereas a heavy dose stimulates the nervous system and this in
turn causes the release of CA by exocytosis (see Smith and Winkler
(13) for review).   It is also widely believed that species variation
plays an important role in determining the mode of CA secretion in-
duced by reserpine.   The present work is designed to test this view
by comparing the responses of adrenomedullary cells of rhesus monkey

---

[1]Manuscript received 20 September 1982; accepted 22 November 1982.

(Macaca mulatta), a species close to man, and Syrian hamsters. Under conditions as similar as possible, animals of each species were injected with a light dose of reserpine after the administration of the ganglion-blocking agent mecamylamine to prevent a possible indirect effect of reserpine on the adrenomedullary cells via the central nervous system. The adrenal medullas were then studied at the fine structural level. Results strongly suggest that species variation plays a role in determining mode of CA secretion after reserpine. A brief summary of this report has previously been published (4).

MATERIALS AND METHODS

Drugs used in this study were the ganglion-blocking agent mecamylamine (a gift from Merck, Sharp and Dohme, Westpoint, Pa.) and reserpine (Serpasil, CIBA, N.J.).

The animals used were divided into groups as follows:

A. Three rhesus monkeys, weighing 4 kgs., were each injected with 20 mgs./kg. weight mecamylamine (the dose was the maximum this species can tolerate) followed one hour later by 1.5 mgs./kg. reserpine (this is the lightest dose which could produce significant fine structural alterations in the adrenal medulla) and sacrificed 24 hours later.

B. One rhesus monkey similarly injected but with distilled water only, sacrificed at 24 hours.

C. Ten Syrian hamsters weighing 100-180 gms., each were injected with 25 mgs./kg. mecamylamine followed one hour later by 1.0 mg./kg. reserpine. (Doses here were determined following the same rules as in monkeys).

D. Three hamsters similarly injected, but with distilled water only and sacrificed at 24 hours.

All injections were intraperitoneal and the drugs dissolved (or diluted) in water only.

Tissue Preparation

For fine structural study of the adrenal medulla, two animals from group A, the one animal in group B, five animals from group C, and animals of group D were lightly anesthetized with sodium pentobarbitol (30 mg./kg.) and perfused through the heart with 4% paraformaldehyde in 0.1 M cacodylate buffer (pH 7.2) at room temperature for three to ten minutes. Adrenal medullas were then dissected out in a bath of fresh fixative under the dissecting microscope, sliced into small pieces (about 1 mm wide) and transferred to small jars containing cold fixatives (4° C) for an additional two hours. Tissues were then post-fixed with 2% OsO_4 in the same buffer at 4° C with continuous agitation for two hours, washed briefly with cold distilled water, dehydrated with ethanol and embedded in araldite 502. Thin sections were stained with uranyl acetate for about 15 minutes and examined under an Hitachi 11C electron microscope. *En bloc* staining with uranyl acetate was avoided, as it caused shrinking of the CA vesicular contents.

To determine extent of loss of CA from tissues two methods were employed:

  1. After brief exposure to cold buffered paraformaldehyde, 10 u cryostat sections of adrenal medullas from animals in groups A-D were exposed to paraformaldehyde vapor (20 minutes at 55° C) and examined under the fluorescence microscope according to the method of El-Badawi and Schenk (7).

  2. The third rhesus monkey of group A was perfused with 3% glutaraldehyde in 0.1 M cacodylate buffer (pH 7.3). The adrenal medullas were excised, diced, and placed in fresh perfusate for two hours. Tissues were then treated with 2.5% potassium dichromate at pH 4.2 (15) and embedded in paraffin. Unstained sections were examined under the light microscope.

To determine the influence of glutaraldehyde (as compared to paraformaldehyde) on reserpine-depleted NA cells, the adrenal medullas of the remaining five hamsters from group C were fixed in 3% glutaraldehyde in 0.1 M cacodylate buffer pH 7.3. The remainder of tissue preparatory steps were the same as in paraformaldehyde-fixed materials described above.

OBSERVATIONS

Adrenal medullas of hamster and rhesus monkey have been previously investigated by light and electron microscopy (2, 3). It has been shown that glutaraldehyde renders noradrenaline (NA) insoluble (5). Based on this reaction, it was shown that NA and adrenaline (A) vesicles were stored in two different cell types in the hamster, whereas in rhesus monkey, both types were stored within the same cell. In the present study, paraformaldehyde was used as perfusate and fixative instead of glutaraldehyde because it offered significantly better cytological preservation of reserpine stimulated adrenomedullary cells than did glutaraldehyde. This is particularly true of stimulated NA cells in hamsters. Paraformaldehyde, unlike glutaraldehyde, does not allow distinction between NA and A vesicles on the basis of the density of staining and the morphology of adreno-medullary cells in both species appeared to be basically the same. Thus, of the control animals, only the adrenal medulla of rhesus monkey is illustrated here. As can be observed in figure (1) CA vesicles were the most prominent feature of the medullary cells. They were homogeneous, osmiophilic, mostly elongated and randomly distributed throughout the cytoplasm. They varied in size over a wide range, but the majority were about 300 nm in greater diameter and 90 nm in lesser diameter. Golgi apparatus was well-developed (Fig. 1 inset) occupying a rather central zone in the cell and was associated with vesicles of moderate electron density and surrounded by cisternae of rough-surfaced endoplasmic reticulum and a few mito-chondria. A few dark-colored vesicles and occasional cilia could also be found in this area.
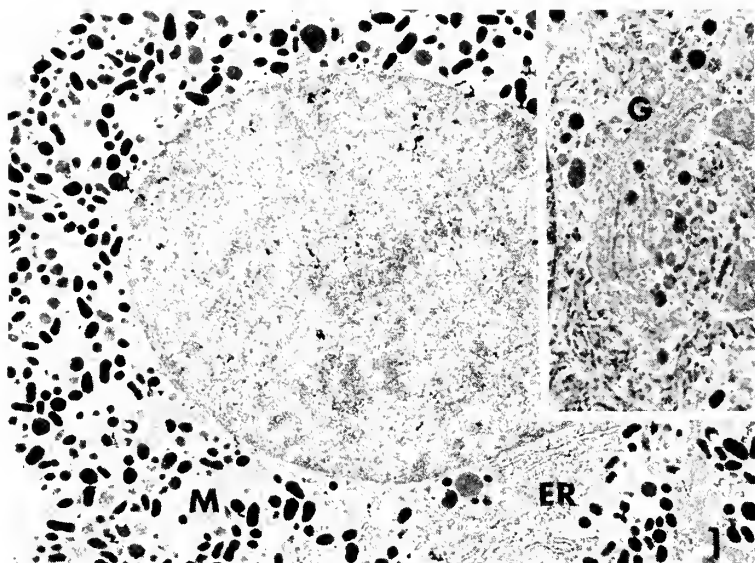
Fig. 1. Adrenomedullary cell of untreated (control) monkey showing densely stained catecholamine vesicles (unlabeled), endoplasmic reticulum (ER) and mitochondria (M). X 14,000. Inset shows a well-developed Golgi apparatus (G) of another cell. Note at the concave aspect of (G) vesicles of moderate electron density (unlabeled) possibly representing immature catecholamine vesicles. X 14,000.

Fine structure of the adrenal medulla of reserpine-injected rhesus monkey

The adrenal medulla here was by no means markedly affected. Judging from the population of CA vesicles remaining, the general impression was one of a mild vesicular depletion for the vast majority of cells (Fig. 2). A few cells comparable in appearance to those in the control animal were considered undepleted, intact cells. The remaining medullary cells were characterized by three types of vesicles: rounded, dark-cored vesicles; light-cored vesicles; and small, electron-lucent vesicles (Fig. 2). The dark-cored vesicles, about 200 nm in diameter, were often comparable in electron opacity to those of the control cells and were probably undepleted CA vesicles. The light-cored vesicles varied in density from moderate to near electron-lucent, but were generally larger than the dark vesicles,

26
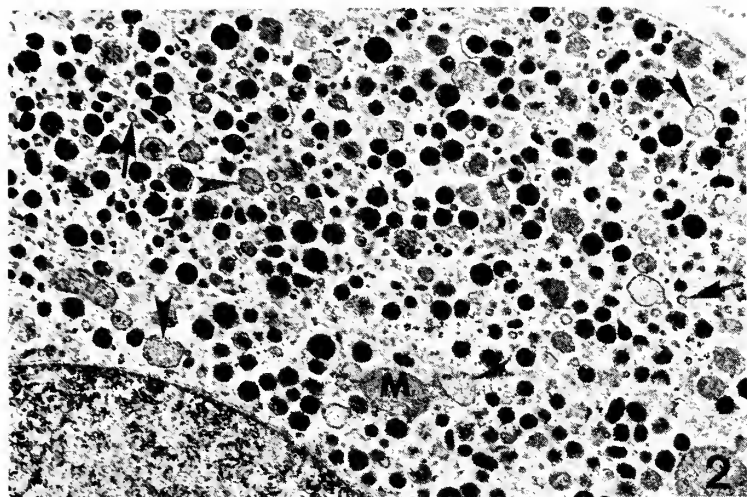
Fig. 2. Adrenomedullary tissue from the monkey which had received 20 mg./kg. mecamylamine followed by a light dose (1.5 mg./kg.) of reserpine (see section of Materials and Methods for details). Three types of vesicles are apparent; dark-cored (unlabeled), light-cored (arrow heads) and small electron-lucent (arrows). Vesicles intermediate between these major types can also be observed. X 16,000.

averaging about 600 nm in diameter. While the number of these vesicles varied from one cell to another, the overall number of all vesicles in any given cell approximated that of the control cells. This was presumably because an increase in the number of one type of vesicles resulted in the decline in number of the other. One possible explanation is that the light vesicles were partially depleted dark-cored CA vesicles. As can be noted from figure 2, both light and dark vesicles were randomly distributed throughout the cytoplasm, with no more affinity for the plasma membrane than in the control tissue. This observation, as will be noted shortly, was in sharp contrast with the results obtained from the medullary cells of hamsters.

The small electron-lucent vesicles, 60-90 nm in diameter, were found singly and less often in groups (Fig. 2) intermingling with the other vesicles. They were not clearly evident in every section of the depleted cells, but when present, their number, as a rule, seemed to increase when the number of the previous vesicles declined. Finally Golgi apparatus was encountered less often here than in control tissue.

Fine structure of the adrenal medulla of reserpine-injected hamsters

Depleted cells here displayed a totally different morphology from those of the rhesus monkey, particularly with respect to the distribution and osmiophilic density of their CA vesicles. As can be noted in figure 3, CA vesicles here were accumulated along the plasma membrane and some were in contact with it, but frank openings at the contact areas were not encountered. Furthermore, these vesicles were all dark-cored, comparable in osmiophilic density to those of the control tissue. The majority showed a round profile and varied in size over a wide range, measuring 80-320 nm in diameter. An appearance of peripheral accumulation of CA vesicles could result from depletion by gradual diffusion of vesicles residing deeper in the cytoplasm. If this were so, partially depleted vesicles should be found in this location. Such vesicles, judged by reduced size or density of their dark cores, were not seen in this material.

Besides the dark-cored vesicles, small electron-lucent (clear) vesicles similar to those described in depleted medullary cells of rhesus monkey, were also noted along the plasma membrane as well as throughout the cytoplasm (Fig. 3). These vesicles, 70-140 nm in diameter, were more abundant in those cells with a reduced number of dark-cored vesicles, and they were rarely encountered in the undepleted medullary cells. The origin or fate of these vesicles could not be determined (see Abraham and Holtzman, (1) for a review).

One other structural alteration which was consistent was the hypertrophy of endoplasmic reticulum (Fig. 3). This organelle in control tissue was usually distinct with compact cisternae (3), but in depleted cells it was expanded with many swollen cisternae.

Evidence for loss of CA

To demonstrate that the cells described above were indeed depleted, two techniques were employed.

     1. Cryostat sections of untreated hamster adrenal medulla were exposed to paraformaldehyde vapor, as described in Materials and Methods, and examined under the fluorescence microscope. They showed bright greenish-yellow fluorescent in NA cells occupying the peripheral medullary zone. In the experimental animals, on the other hand, the corresponding cells displayed decisively weaker fluorescent activity which indicates that a net loss of NA did occur after the administration of reserpine. In rhesus monkey, possibly because of the absence of medullary cells storing only NA, the fluorescent technique produced inconclusive results. Sections from both untreated and experimental animals displayed near negative fluorescence reaction. As an alternative procedure, the chromaffin reaction was employed.
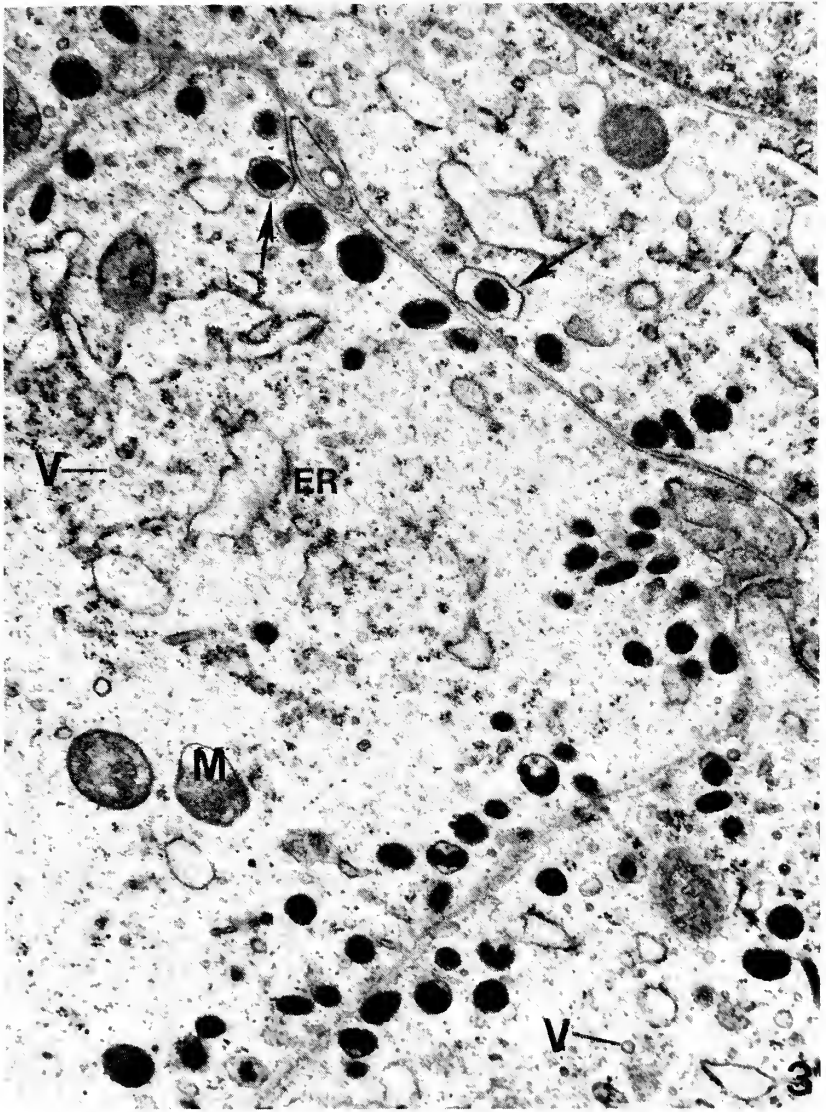
Fig. 3. Cells from adrenal medulla of mecamylamine (25 mg./kg.) - reserpine (1 mg./kg.) treated hamster. Note frequency of CA vesicles along the plasma membrane and examples of contact between the vesicular membranes and the plasma membrane (arrows). V= electron-lucent vesicles. M= mitochondria. ER= endoplasmic reticulum with swollen cisternae. X 27,700.

2. Rhesus monkey medulla was treated with potassium di-chromate at a low pH (see Materials and Methods) and examined under light microscope. In the sections of untreated monkeys, brownish coloration (chromaffin reaction) was observed through-out the medulla (not illustrated). In the reserpinized animals, however, the reaction ranked from weak to near negative. This was taken to suggest that in monkeys also, reserpine had caused net loss of CA.

DISCUSSION

Although the number of monkeys in this experiment was small, in each animal CA depletion was demonstrated by the potassium dichromate test at the light microscopic level. This clearly indicates that the fine structural alterations, evoked by reserpine, were indeed due to CA depletion from the adrenomedullary cells. Reserpine here was pre-sumably acting directly on the adrenomedullary cells; its indirect (neurogenic) action had been blocked by mecamylamine. As was noted above, in depleted medullary cells of rhesus monkey, the remaining vesicles varied in osmiophilic density, some were dark comparable to those of control cells while others were light. The latter were sug-gested to be partially depleted vesicles. It could, however, be argued that these vesicles instead were newly formed (immature) ones in the process of CA synthesis and/or uptake. This alternative was unlikely because the overwhelming evidence indicated that both meca-mylamine and reserpine were strong inhibitors of new CA synthesis and uptake by the vesicles (9, 11). Mecamylamine exerts its effect indi-rectly; by blocking the neurogenic stimulation of tyrosine hydroxy-lase which is a rate limiting enzyme in CA synthesis (11). Reser-pine, not only depletes CA vesicles but also effectively inhibits the uptake of new CA by the vesicles for weeks (6, 9, 12). Since the tissue in question was taken only 24 hours after the administration of the drug, it is unlikely that significant CA synthesis or uptake had occurred in the adrenomedullary vesicles.

In the hamster, while depletion is indicated by a reduction in number of CA vesicles, the remaining vesicles were close to the plasma membrane or in contacrt with it and were comparable in osmio-philic density to those of untreated animals. The characteristic light vesicles seen in the monkey were absent in this animal.

Two possible alternative explanations for these results are: 1) In the hamster, adrenomedullary secretion evoked by reserpine took place by means of exocytosis, whereas in monkey, by gradual release (molecular diffusion) of vesicular contents to the cytoplasm and from there to the cell exterior. 2) In the monkey, secretion occurred also by exocytosis except that CA vesicles here moved very rapidly to the cell periphery, discharged a portion of their contents by exocy-tosis, thus becoming light vesicles, and quickly moved away from the cell periphery so that they were rarely "arrested" close to the plas-ma membrane by the process of fixation. This hypothesis however, suffers at least one weakness when it assumes that only a portion of vesicular content was released at a given time. It is generally

agreed that exocytosis involves the release of the total vesicular contents at one time (10, 14). This writer is aware of the diffi-culty in drawing conclusions about dynamic process from static pictures and more research involving techniques such as freeze-fracture is perhaps necessary to gain further insight into this complicated process. Nevertheless, the fact remains that there was a conspicuous difference in the morphologic distributions of adreno-medullary vesicles between these two species after reserpine.

Finally a word about the problem of proper preservation of stim-ulated adrenomedullary cells is perhaps necessary. Coupland (6) was the first to call attention to the observation that stimulated adre-nomedullary cells were more difficult to properly preserve that non-stimulated ones. The present author found this to be particularly true in the case of glutaraldehyde fixation of reserpine-stimulated NA cells in hamsters. After a light dose of reserpine these cells under the electron microscope appeared virtually devoid of formed elements, mitochondria and plasma membrane were disrupted, and the occasional CA vesicles encountered were either devoid of their envel-oping membranes, or at best, surrounded by discontinuous ones. This obstacle prevented any meaningful analysis of the cytological altera-tions induced by reserpine. It was perhaps due to this technical difficulty that the literature on the adrenal medulla lacks any report dealing with stimulated NA cells in which glutaraldehyde was used.

In contrast, the 4% paraformaldehyde-fixed medullary tissues from hamsters which had received a comparable dose of reserpine were undoubtedly better preserved, displaying relatively minimal cytolog-ical disruption; and preservation of the remaining vesicles in the depleted NA cells was unquestionably more successful than in gluta-raldehyde-fixed samples. It must be reiterated however, that this adverse glutaraldehyde-induced effect can only be observed in the stimulated NA cells. One thus can conduct a meaningful fine structu-ral study using glutaraldehyde or double aldehyde on stimulated A cells after agents such as insulin or a heavy dose of reserpine (1, 8, also unpublished data of this author).

LITERATURE CITED

1. Abrahams, S.J. and E. Holtzman. 1973. Secretion and endocytosis in insulin-stimulated rat adrenal medulla cells. J. Cell Biol. 56:540-558.

2. Al-Lami, F. 1969. Light and electron microscopy of the adrenal medulla of Macaca mulatta monkey. Anat. Rec. 164:317-332.

3. Al-Lami, F. 1970. Follicular arrangements in hamster adrenomedullary cells: Light and electron microscopic study. Anat. Rec. 168:161-178.

4. Al-Lami, F. 1982. The effect of species variation on the mode of adrenomedullary secretion. Anat. Rec. 202:5A.

5. Chungsamarnyari, N., Fujioka and J. Kitoh. 1981. Correlative light, fluorescence and electron-microscopic studies of catecholamine-storing cells in the adrenal medulla of the domestic fowl. Cell Tissue Res. 217:471-477.

6. Coupland, R.E. 1965. The natural history of the chromaffin cell. Longmans, Green and Co., Ltd., London.

7. El-Badawi, A. and E.A. Schenk. 1967. Histochemical methods for separate, consecutive and simultaneous demonstration of acetylcholinesterase and norepinephrine in cryostat sections. J. Histochem. Cytochem. 15:580-587.

8. Elfvin, L.G. 1968. Effects of reserpine on the surface of chromaffin cells in the rat adrenal medulla. J. Ultrastruct. Res. 21:459-473.

9. Goodman, S. and A. Gilman. 1975. Pharmacolcgic basis of therapeutics. MacMillan Publishing Co., N.Y.

10. Normann, T.C. 1976. Neurosecretion by exocytosis. International Rev. of Cytol. 46:1-77.

11. Patrick, R.L. and N. Kirshner. 1971. Acetylcholine-induced stimulation of catecholamine recovery in denervated rat adrenals after reserpine-induced depletion. Molec. Pharm. 7:389-396.

12. Paton, D.M. 1976. The mechanism of neuronal and extraneuronal transport of catecholamine. Raven Press. N.Y.

13. Smith, A.D. and H. Winkler. 1972. Fundamental mechanisms in the release of catcholamines. In: Handbook of Experimental Pharmacology. Vol. 33 (Suppl.), H. Blaschko and E. Muscholl, ed. Springer-Verlag, N.Y., pp. 538-617.

14. Viveros, O.H., Arqueros, L. and Kirshner, N. 1969. Quantal secretion from the adrenal medulla: All-or-none release of storage vesicle content. Science, 165:911-912.

15. Wood, J.G. 1967. The relationship of nucleotidase activity to catecholamine storage sites in adrenomedullary tissue. Amer. J. Anat. 121:671-704.

PHYSIOLOGY OF INSECT VITELLOGENESIS:
I.   PROTEIN UPTAKE AND SYNTHESIS BY THE OVARY (A REVIEW)[1]

James T. Bradley
Department of Zoology-Entomology
Auburn University, AL   36849

INTRODUCTION

Vitellogenesis, the process of egg yolk formation, offers excep-
tional versatility as a model for approaching basic questions in
cellular and molecular biology. Animals producing yolky eggs include
fish, reptiles, birds, amphibians, echinoderms, and arthropods. Al-
though both protein and lipid are major components of egg yolk, for-
mation of the protein portion of the yolk has received the most in-
vestigative attention. Vitellogenesis is under endocrine control in
most animals and involves at least two experimentally separable proc-
esses: the synthesis of vitellogenin (VG), the blood-borne protein
precursor of egg yolk protein, and the selective uptake of VG by
developing oocytes.   After its incorporation into vitellogenic
oocytes, VG is referred to as vitellin (VN) (28).   In insects, VN
accounts for 60-90% of the soluble yolk protein in fully grown
oocytes (28).

Vitellogenin is produced by the liver in vertebrates (10, 62)
and by an analogous organ, the fat body, in insects (20, 47).   Fol-
lowing its synthesis and post-translational processing (31, 51, 64),
VG is secreted into the blood via which it reaches the ovary.   Induc-
tion of vitellogenin synthesis in most animals is normally a female-
specific and stage-specific event controlled by estrogen in verte-
brates (10, 18, 54, 64) and juvenile hormone in most insects (9, 19,
20).   The hormonal regulation of extraovarian *in vivo* VG synthesis in
insects has been extensively reviewed (19, 20, 23).   The biochemical
properties of insect VG and VN have also been reviewed (28, 66), and
an evolutionary model for insect VN's based on their polypeptide sub-
unit and amino acid compositions has been proposed (29, 30).

This article reviews the role of the ovary in insect vitello-
genesis. Specifically, the uptake of extraovarian VG by vitellogenic
follicles and protein synthesis by the ovary itself during vitello-
genesis will be discussed. (See also note at the bottom of page 47.)

OVARY MORPHOLOGY

Interpretation of the physiological and biochemical activities of the developing insect ovary requires an appreciation of its morphology, a subject which has been reviewed frequently (41, 52, 65). The structural and functional unit of an insect ovary is the ovariole, an often filamentous appearing structure containing a linear array of developing follicles (Fig. 1a and b). Oogonia and younger follicles are found at the anterior end of the ovariole, and the developmentally oldest follicle is at the posterior end of the ovariole. The number of ovarioles per ovary is a species characteristic which varies from one to several hundred.

Ovarioles of most insects can be classified as either panoistic or meroistic depending on the type of ovarian tissue which provides nutritive support for the developing oocytes. In panoistic ovarioles (Fig. 1a), the only trophic tissue is a single layered follicular epithelium surrounding each growing oocyte. The oocytes of meroistic ovarioles (Fig. 1b-d) also possess a follicular epithelium, but in addition, they are associated with nurse cells or trophocytes derived from the germ line. During oogenesis, oocytes in panoistic ovarioles are active in RNA synthesis; whereas in meroistic ovarioles, oocyte nuclei are relatively inactive, and nurse cell nuclei synthesize RNA which is then transported to the oocyte via cytoplasmic channels. Evolutionarily, the panoistic ovary is considered the more primitive, being found in the Thysanura, Ephemeroptera, Odonata, Plecoptera, Orthoptera, Isoptera, Embioptera, Thysanoptera, and Siphonaptera (19).

The generalized insect ovariole consists of four regions. Anterior to posterior, these are the terminal filament, germarium, vitellarium, and ovariole stalk (Fig. 1a). The terminal filaments, along with anterior extensions of the connective tissue surrounding each ovariole, form an ovariole ligament (52) by which each ovary is attached to the body wall. Separating the terminal filament and the germarium is a short constricted region called the transverse septum. In the germarium are oogonia, primary oocytes, and mesodermally derived prefollicular cells. Formation of the definitive follicle occurs within the germarium, and the proximal end of the vitellarium is defined by the anterior most follicle which fills the entire width of the ovariole. The vitellarium accounts for most of the overall length of the ovariole. It can be subdivided into three zones on the basis of follicle development: an anterior *previtellogenic zone*, consisting of several follicles, a *vitellogenic zone* containing one or two follicles engaged in yolk deposition, and the *mature follicle* containing a chorionated oocyte which will pass from the distal end of the ovariole through the ovariole stalk into the lateral oviduct.

This review, which deals with the manipulation of extraovarian VG and protein synthesis by follicles in the *vitellogenic zone*, addresses the question: What are the morphological and biochemical correlates associated with the ability of follicles in this region of the ovariole to take up VG from the hemolymph? What is the functional significance of protein synthesis in the vitellogenic ovary itself during yolk formation?
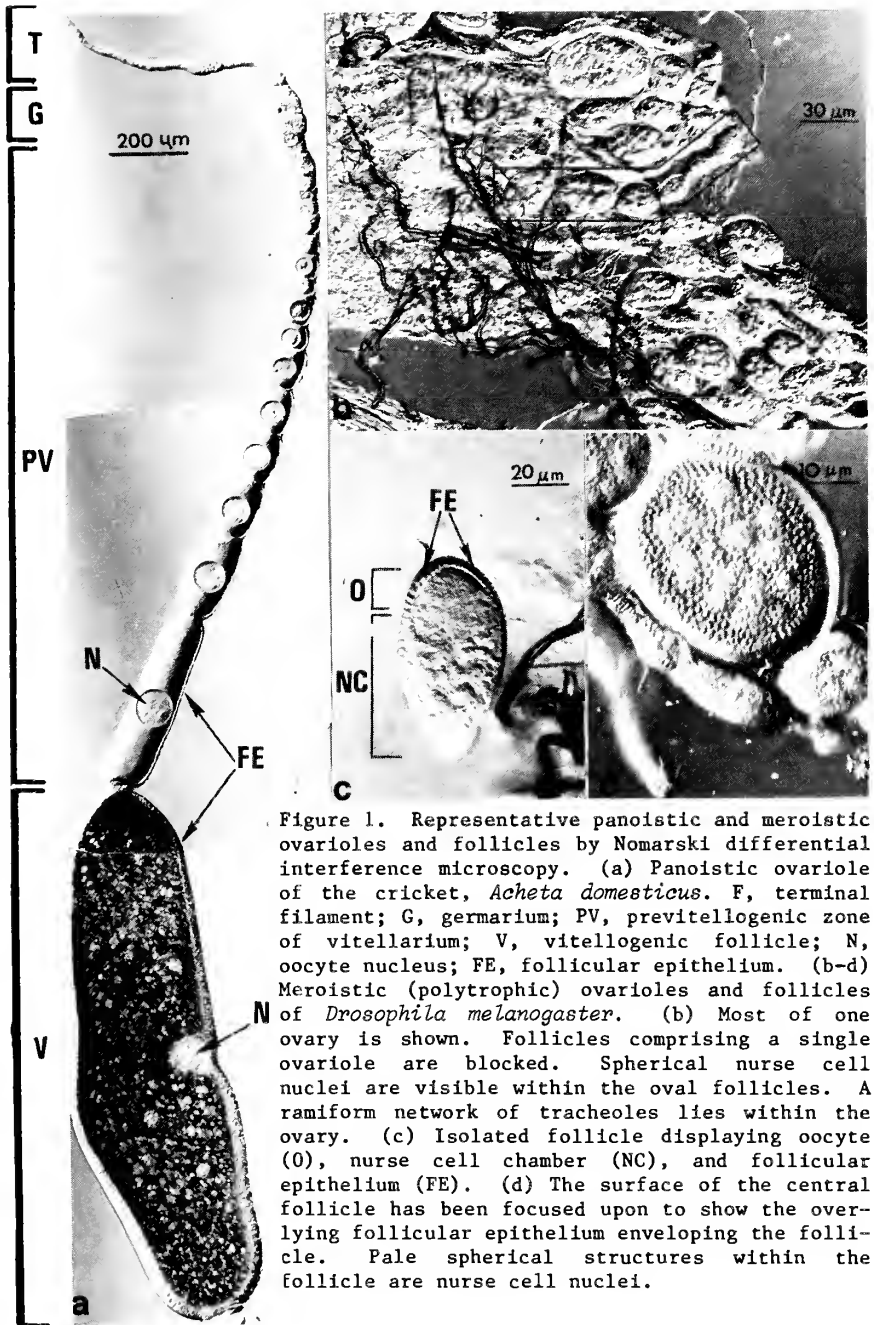
Figure 1. Representative panoistic and meroistic ovarioles and follicles by Nomarski differential interference microscopy. (a) Panoistic ovariole of the cricket, *Acheta domesticus*. F, terminal filament; G, germarium; PV, previtellogenic zone of vitellarium; V, vitellogenic follicle; N, oocyte nucleus; FE, follicular epithelium. (b-d) Meroistic (polytrophic) ovarioles and follicles of *Drosophila melanogaster*. (b) Most of one ovary is shown. Follicles comprising a single ovariole are blocked. Spherical nurse cell nuclei are visible within the oval follicles. A ramiform network of tracheoles lies within the ovary. (c) Isolated follicle displaying oocyte (O), nurse cell chamber (NC), and follicular epithelium (FE). (d) The surface of the central follicle has been focused upon to show the overlying follicular epithelium enveloping the follicle. Pale spherical structures within the follicle are nurse cell nuclei.

VITELLOGENIN UPTAKE

Vitellogenin is taken up from the hemolymph by micropinocytosis of the plasma membrane of vitellogenic oocytes. In order to approach the oocyte cell membrane, hemolymph proteins must first cross a thin connective tissue sheath surrounding each ovariole, a basement membrane, and the single layered follicular epithelium. The follicular epithelium completely surrounds each oocyte in panoistic ovarioles. In meroistic ovarioles, it lies over all but that anterior region of the oocyte which is associated with the nurse cells (Fig. 1c and d). Although there is no evidence that either the ovariole sheath or the epithelial basement membrane performs a regulatory function during vitellogenesis, the follicular epithelium plays a crucial and active role in VG uptake.

The existence of intercellular spaces between adjacent follicular epithelial cells during vitellogenesis is well documented (15, 17, 61), and the presence of VG within these spaces has been demonstrated using immunochemical techniques and by autoradiography of vitellogenic follicles exposed to radioactively labeled VG (42, 45, 56, 60). Thus, it is clear that VG reaches the oocyte surface by moving around follicle cells rather than through them.

Many changes in the morphology of the follicular epithelium accompany the onset and progression of the vitellogenic state. These changes are well described in crickets (43, 44) and probably typify those occurring in most insects. Young previtellogenic follicles in the anterior region of the vitellarium possess a squamous epithelium with convexo-convex shaped nuclei located at varying distances from each other. As the cytoplasmic volume of the previtellogenic oocyte increases, follicle cells undergo mitosis and the nuclei become more spherical, lying more closely to each other as the epithelium becomes columnar. The epithelium of follicles in which the onset of vitellogenesis is imminent is said to be in the "sphere phase" (44) in reference to the shape of the nuclei. In this stage, the border between adjacent epithelial cells is smooth or slightly wavy, and the border at the oocyte surface is deeply folded. The oolemma itself becomes pinocytically active, a manifestation of VG uptake (21). Also during the "sphere phase" of follicle development, an endomitotic increase in the DNA content of some follicle cell nuclei begins.

The remainder of the nuclei continue dividing mitotically until the beginning of the next phase of follicle development, the "anticline phase" (44). During this period, follicle cell nuclei enlarge and elongate perpendicular to the surface of the follicle, becoming dumbbell shaped due to a constricting furrow perpendicular to the longitudinal axis of the nucleus (cover photo). As yolk deposition continues, boundaries between adjacent follicle cells become clearly visible in unstained preparations of the house cricket, *Acheta domesticus*. This is undoubtedly due to the presence of intercellular spaces between adjacent epithelial cells. The development of inter-

follicular cell spaces has been extensively studied in the blood-sucking bug, *Rhodnius prolixus*, where it has been termed follicle cell patency (17). Patency in *Rhodnius* is due at least in part to a decrease in follicle cell volume resulting from a tissue-specific, juvenile hormone-dependent activation of Na^+-K^+ ATPase activity in the follicular epithelium (15).[2] In *Rhodnius*, follicle cell patency in the basal follicles of the ovariole coincides with the onset of vitellogenesis and disappears when yolk deposition is finished. In *A. domesticus*, when vitellogenic oocytes have reached about one half the length of fully grown oocytes, the longitudinal axes of "anticline phase" follicle cell nuclei slowly rotate 90° so that the halves of each constricted nucleus come to lie next to each other parallel to the oocyte surface. During this "pericline phase" (44), the furrow which constricts each nucleus deepens and in some cel's results in an amitotic nuclear division (43, 44). Mitosis in th follicular epithelium ceases at the end of the "sphere phase", and subsequent vitellogenic oocyte growth is accommodated by the epithelium changing from columnar back to squamous. After vitellogenesis is completed, the follicular epithelium secretes the vitelline membrane and the chorion between itself and the oocyte.

Uptake of extraovarian VG by vitellogenic follicles is a highly selective process which can occur against a concentration gradient (1, 2, 40, 55). Even though the concentrations of other proteins in the hemolymph are greater than that of VG, VG is preferentially incorporated by the oocyte. It also appears that the recognition system(s) may interact with species-specific determinants in the VG molecule since in most cases follicles preferentially take up VG's from their own or closely related species (6, 34, 39). Although the means by which oocytes preferentially take up VG is not yet fully understood , there is evidence for a least two potential recognition sites for VG within the follicle, one at the level of the follicular epithelium and another at the oocyte cell membrane.

In several insect species, follicle cells appear to secrete non-VG protein into the interfollicular cell spaces during vitellogenesis (3, 8, 25). The synthesis and secretion of these proteins are discussed in the next section. It has been proposed that these proteins may possess an affinity for VG and serve to concentrate VG within the follicle cell spaces and/or function as a molecular bridge between VG and putative receptors in the oolemma (5, 24). But the possibility has also been noted that protein binding in the follicle cell spaces may result in a nonspecific concentrate of all available hemolymph proteins from which VG is then selectively removed during

---

[2]An elegant experiment involving transplantation of ovaries into male abdomens of the cockroach, *Eublaberus posticus*, showed that the initiation of VG uptake requires juvenile hormone (JH), the presence of circulating VG being insufficient to initiate yolk deposition (7). Whether the action of JH in this species involves activation of an ion pump as described above in *Rhodnius* is not known.

yolk deposition, since injected foreign proteins as well as VG have been found to accumulate in the spaces (4).

A stage-specific intercellular matrix between adjacent follicle cells of vitellogenic oocytes has been described in the silkmoth, *Hyalophora cecropia*, (58). The matrix can be labeled with ^{35}S-sulfate and ^{3}H-glucosamine during vitellogenesis and is sensitive to hyaluronidase, indicating that the matrix may contain a glucosamino-glycan. After vitellogenesis, no new matrix material is produced, and the matrix remaining between follicle cells becomes disassembled. It was suggested that the matrix may help maintain intercellular diffusion channels from the hemolymph to the oocyte surface and/or bind and thereby concentrate VG from the hemolymph in the region of oocyte pinocytic activity. The phylogenetic distribution of this type of vitellogenic matrix in insects is not yet known, but in the milkweed bug, *Oncopeltus fasciatus*, neither glucosamine nor sulfate is incorporated into the interfollicular cell matrix during vitello-genesis (35).

The movement of VG across the oolemma by micropinocytosis may also be selective. Micropinocytosis in vitellogenic oocytes from several orders of insects is known to involve the formation of clath-rin coated pits and vesicles (21, 49, 61), ultrastructural features characteristic of receptor-mediated endocytosis (26). Certain char-acteristics of the binding of the major blood-borne yolk proteins, VG and phosvitin, to the hen oocyte surface has recently been reported in chickens (69), and these may provide insight into the situation in insects. The binding of each protein to the oocyte has a K_D of about 6×10^{-7}M at an optimum pH of 6.0, the same pH as that of the yolk contents. Although both proteins contain phosphate, the binding specificity appears not to be due to polymeric phosphate, since RNA fails to compete with the binding of either yolk protein. The bind-ing of VG and phosvitin to the oocyte in chickens may involve cell-type-specific membrane receptors since chicken erythrocytes fail to bind the proteins. *In vitro* systems for studying VG uptake by insect oocytes have been developed (22, 32, 50) and may provide additional information about the VG-recognition mechanism(s) operating in insects.

PROTEIN SYNTHESIS IN THE OVARY

Not only the fat body, but also the insect ovary is active in protein synthesis during vitellogenesis. Several electrophoretically distinct polypeptides are produced by vitellogenic ovaries (5, 24, 67), some of which appear to be unique to the ovary and others that are also synthesized by the fat body and/or are present in the hemo-lymph. It now seems likely that the major portion of the protein produced by the ovary during vitellogenesis is a product of the fol-licle cells of vitellogenic oocytes. Included among the proteins produced by vitellogenic follicles are at least two apparently func-tionally different classes of macromolecules having roles in vitello-genesis. These are the putative VG-binding proteins secreted into the spaces between follicle cells and the VG's themselves. Although

numerous other types of proteins are certainly synthesized by vitel-
logenic ovaries, they remain virtually uncharacterized and their
functional significance unknown, with one notable exception.[3]

It is important to note that although follicle cell protein
products from several species possess some of the properties expected
of proteins which preferentially concentrate hemolymph VG near the
surface of vitellogenic oocytes, there is not yet an unequivocal dem-
onstration that any of them actually serve this function during
vitellogenesis. The best characterized of these putative VG-binding
proteins is a histidine-rich glycoprotein termed paravitellogenin
which is synthesized and secreted by the follicular epithelium of *H.
cecropia* during vitellogenesis. This protein eventually accounts for
up to 10% of the extractable egg proteins in this species (3, 57).
Hyalophora paravitellogenin may be identical to or a multimer of a
55,000 dalton polypeptide identified by SDS-polyacrylamide gel elec-
tophoresis. The latter is the principal product secreted by the
epithelium of vitellogenic oocytes and becomes incorporated into yolk
spheres of the oocyte (3, 5). It is also known that *Hyalophora*
oocytes from which the follicular epithelium has been removed fail to
incorporate VG even in the presence of follicle cell protein (2).
This along with the finding that extracted follicular protein has a
greater affinity for VG than for male hemolymph proteins (1) led to
the suggestion that follicle cell protein may mediate the concentra-
tion of VG within the follicle cell spaces and thereby facilitate the
pinocytic uptake of VG by the oocyte (5). It was suggested that the
follicle cell product may be incorporated simultaneously with VG, but
more recently it was noted that most of the paravitellogenin enters
the oocyte after the vitellogenic growth of the oocyte is nearly
complete (59).

Proteins synthesized by the follicular epithelium and secreted
into the follicle cell spaces during vitellogenesis have also been
described in the cockroach, *Periplaneta americana* (8), and the lo-
cust, *Locusta migratoria* (24, 25). In *Periplaneta,* a histidine-
labeled follicle cell product was shown by autoradiography to move
from the follicle cell cytoplasm into the intercellular spaces and
finally into nascent yolk spheres in the ooplasm. The synthesis of
this product was shown to be juvenile hormone-dependent and to occur
exclusively in vitellogenic follicles. The *Locusta* follicle cell
protein has been shown by indirect immunofluorescence to also be
localized in the interfollicular cell spaces of follicles active in
VG uptake. But it differs from *Hyalophora* paravitellogenin in that
it is not detected in the oocyte, is not a glycoprotein, is not en-

---

[3]Juvenile hormone-induced thymidine kinase activity in the adult
ovary of the cockroach, *Leucophaea maderae,* during the period of
terminal oocyte growth, appears to involve *de novo* synthesis of the
enzyme by the follicular epithelium and is correlated with an in-
crease in DNA synthesis in the follicle cells, probably leading to
polyploidization (36, 37, 38).

riched in histidine, and has a molecular weight of only 18,500 daltons. Just how widespread the occurrence of follicle cell products like those found in the three species above is remains to be seen.

Another protein product of vitellogenic ovaries in some species is VG itself. Ovary-derived VG has been demonstrated in the cockroach, *Leucophaea maderae* (67), and in some *Drosophila* species (27, 33, 53). Ovarian production of VG has been studied most intensively in *Drosophila melanogaster*, a species possessing three distinct VGs (62).

Decades ago it was shown that previtellogenic pupal ovaries from *D. melanogaster* would develop mature oocytes after being transplanted into adult males, other pupae, or even larvae (13). More recently, when previtellogenic ovaries from two *Drosophila* species possessing electrophoretically distinguishable VG's were co-cultured in male hosts, it was found that the resulting fully developed oocytes of the transplant contained VG of the donor species but not that of the host species (53). This indicated autonomous VG synthesis by the ovary. The follicular epithelium of vitellogenic oocytes has since been shown to be the ovarian site of VG synthesis in *D. melanogaster* (14). Contrary to one report (27), the nurse cells appear not to synthesize VG (14), and only those follicle cells actually overlaying the oocyte possess detectable VG messenger RNA. It appears that the ovary makes a major contribution to the yolk protein of developing oocytes in *Drosophila* as it produces 10 to 35% of the total messenger RNA for each of the three VG's (14). The route of entry into the oocyte of VG synthesized by the follicular epithelium is probably no different than that of fat body-derived VG, although this has not yet been demonstrated.

It is interesting that the path(s) may be different by which VG synthesis is regulated in the fat body and in the ovary of *Drosophila*. Vitellogenin synthesis in the adult fat body can be stimulated by either ecdysterone or juvenile hormone, whereas the ovary responds only to juvenile hormone (48). Furthermore, neither the event of eclosion nor an adult body environment is needed to trigger VG synthesis in the ovary. Rather, the regulation of ovarian VG synthesis appears to be autonomous to the ovary itself, and the development of competence to initiate subsequent VG synthesis occurs in the pupal ovary early in metamorphosis (12). As with the putative VG-binding proteins discussed above, the phylogenetic occurrence of autonomous ovary-derived VG is not yet known.

Other proteins whose functions remain unknown are synthesized by the insect ovary. The synthesis of one or more ovary-specific phosphoproteins was described in two anautogenous and one autogenous[4] mosquito species (11). The rates of synthesis of these proteins,

---

[4]Anautogenous mosquitoes require a blood meal for subsequent egg production whereas autogenous ones do not.

both *in vivo* and *in vitro*, peak 12 to 30 hours after the rate of VG synthesis peaks, a time during which rapid vitellogenic follicle growth is occurring. In the silkworm, *Bombyx mori*, at least one major egg-specific protein is synthesized in the ovary of the pharate adult concurrently with fat body VG synthesis and rapid vitellogenic oocyte growth (45). The protein, termed SP-E-2, has been identified rigorously by column chromatography and several immunochemical techniques. It is present in a protein extract from mature, ovulated eggs and is undetectable in the hemolymph of the larva or pharate adult of either sex. *In vitro* tissue cultures indicated that the ovary is the sole source of the protein. Whether the coincident synthesis of VG and SP-E-2 reflects coordinated hormonal regulation of their respective genes is not known, but ecdysterone *in vitro* does stimulate the rate of post-induction synthesis of each protein, VG by the fat body and SP-E-2 by the ovary. The cellular site(s) of synthesis of the ovary-specific proteins of *Bombyx* and mosquitoes remains to be determined.

Finally, a remarkable example of the protein synthesizing capacity of the ovary of some insects is found in the physogastric queen of the termite, *Macrotermes sybhyalinus* (68). A single queen may daily produce up to 40,000 eggs having a wet weight of 4 to 5 grams, corresponding to about one third the body weight of the insect. During this period of egg production, the fat body of the queen is inactive in protein synthesis, both *in vivo* and *in vitro*, compared to the ovaries. Thus, the ovary is presumed to be the site of synthesis of most of the egg yolk protein required for this prodigious reproductive output. The presence of a well developed rough endoplasmic reticulum in the follicle cells suggests that they are major contributors of this ovary-derived yolk protein.

SUMMARY

1. Certain aspects of vitellogenesis, egg yolk formation in developing oocytes, are useful as model systems for approaching basic problems in eukaryotic cell biology. Two areas now benefiting from the use of vitellogenic systems are the hormonal regulation of gene expression and the mediation of cell surface-protein interactions.

2. Vitellogenins (VG) are the protein precursors to the major egg yolk proteins. Vitellogenins are generally high molecular weight glycoproteins which are synthesized in the liver of vertebrates and the fat body of insects. They are sequestered from the blood by vitellogenic follicles during oocyte development. Both VG synthesis by the fat body and its uptake by the oocyte are under hormonal control in most insects.

3. Vitellogenin uptake by the oocyte is a highly selective process. During the onset of vitellogenesis, extracellular channels appear within the follicular epithelium surrounding the oocyte. Circulating VG becomes concentrated in these spaces prior to its movement into the oocyte by receptor-mediated endocytosis.

4. The concentration of VG within the follicle cell spaces may be facilitated by proteins and/or a glucosaminoglycan-containing matrix synthesized and secreted into the spaces by the follicle cells of vitellogenic oocytes.

5. Vitellogenic ovaries are active in protein synthesis, and the follicular epithelium of vitellogenic oocytes is a major site of ovarian protein synthesis. Follicle cell products in some species include putative VG-binding proteins, VG itself, and other proteins whose functions are unknown. How widespread VG synthesis by the ovary is among insects is not yet known.

ACKNOWLEDGEMENTS

REFERENCES

1. Anderson, L.M. 1970. Protein synthesis and incorporation by isolated *Cecropia* oocytes. Am. Zool. 10: 526.

2. Anderson, L.M. 1971. Protein synthesis and uptake by isolated *Cecropia* moth oocytes. J. Cell Sci. 8: 735-750.

3. Anderson, L.M. and W.H. Telfer 1969. A follicle cell contribution to the yolk spheres of moth oocytes. Tiss. Cell 1: 633-644.

4. Anderson, L.M. and W.H. Telfer 1970. Extracellular concentration of proteins in the *Cecropia* moth follicle. J. Cell. Physiol. 76: 37-54.

5. Bast, R.E. and W.H. Telfer 1976. Follicle cell protein synthesis and its contribution to the yolk of the *Cecropia* moth oocyte. Develop. Biol. 52: 83-97.

6. Bell, W.J. 1972. Yolk formation by transplanted cockroach oocytes. J. exp. Zool. 181: 41-48.

7. Bell, W.J. and R.H. Barth 1971. Initiation of yolk deposition by juvenile hormone. Nature New Biol. 230: 220-222.

8. Bell, J.W. and G.R. Sams 1974. Factors promoting vitellogenic competence and yolk deposition in the cockroach ovary: the post-ecdysis female. J. Insect Physiol. 20: 2475-2485.

9. Benford, H.H. and J.T. Bradley 1982. Juvenile hormone induction of cricket vitellogenin synthesis. J. Ala. Acad. Sci. 53(3): 36.

10. Bergink, E.W., R.A. Wallace, J.A. van de Berg, E.S. Bos, M. Gruber and G. AB 1974. Estrogen-induced synthesis of yolk proteins in roosters. Am. Zool. 14: 1195-1206.

11. Borovsky, D. and E. Van Handel 1980. Synthesis of ovary-specific proteins in mosquitoes. Int. J. Invert. Reprod. 2: 153-163.

12. Bownes, M. 1982. Ovarian yolk-protein synthesis in *Drosophila melanogaster*. J. Insect Physiol. 28: 953-960.

13. Bodenstein, D. 1947. Investigations on the reproductive system of *Drosophila*. J. exp. Zool. 104: 101-152.

14. Brennan, M.D., A.J. Weiner, T.J. Goralski and A.P. Mahowald 1982. The follicle cells are a major site of vitellogenin synthesis in *Drosophila melanogaster*. Develop. Biol. 89: 225-236.

15. Cruickshank, W.J. 1972. Ultrastructural modifications in the follicle cells and egg membranes during development of flour moth oocytes. J. Insect Physiol. 18: 485-498.

16. Davey, K.G. 1981. Regulation of cell volume in follicle cells of *Rhodnius* by JH. In: *Juvenile Hormone Biochemistry*, G.E. Pratt and G.T. Brooks, eds. Elsevier/North-Holland Biomedical Press, pp. 233-240.

17. Davey, K.G. and E. Huebner 1974. The response of the follicle cells of *Rhodnius prolixus* to juvenile hormone and antigonadotropin *in vitro*. Can. J. Zool. 52: 1407-1412.

18. Emmerson, J., B. Korsgaard and I. Petersen 1979. Dose response kinetics of serum vitellogenin, liver DNA, RNA, protein and lipid after induction by estradiol-17 in male flounders (*Platichytys flesus* L.). Comp. Biochem. Physiol. 63B: 1-6.

19. Engelmann, F. 1970. In: *The Physiology of Insect Reproduction*. Pergamon, Oxford, 307 pp.

20. Engelmann, F. 1979. Insect vitellogenin: identification, biosynthesis, and role in vitellogenesis. Adv. Insect Physiol. 14: 49-108.

21. Favard-Sereno, C. 1969. Capture de polysaccharides par micropinocytose dans l'ovocyte du grillon en vitellogenese. J. Microscipie 8: 401-414.

22. Ferenz, H.J. and E.W. Lubzens 1981. Vitellin and vitellogenin incorporation by isolated oocytes of *Locusta migratoria migratorioides* (R.F.) J. Insect Physiol. 27: 869-875.

23. Fuchs, M.S. and S.H. Kang 1981. Ecdysone and mosquito vitello-genesis: A critical appraisal. Insect Biochem. 11: 627-633.

24. Glass, H. and H. Emmerich 1981. Properties of two follicle proteins and their possible role for vitellogenesis in the African locust. Wilhelm Roux Arch. Develop. Biol. 190: 22-26.

25. Glass, H. and H. Emmerich 1981. Immunofluorescent localization of two SDS-soluble proteins in maturing terminal follicles of *Locusta migratoria*. Wilhelm Roux Arch. Develop. Biol. 190: 27-32.

26. Goldstein, J.L., R.W.G. Anderson and M.S. Brown 1979. Coated pits, coated vesicles, and receptor-mediated endocytosis. Nature 279: 679-685.

27. Gutzeit, H.O. 1980. Yolk synthesis in ovarian follicles of *Drosophila*. Wilhelm Roux Arch. Develop. Biol. 189: 221-224.

28. Hagedorn, H.H. and J.G. Kunkel 1979. Vitellogenin and vitellin in insects. Ann. Rev. Entomol. 24: 475-505.

29. Harnish, D.G. and B.N. White 1982. Insect vitellins: identifi-cation, purification, and characterization from eight orders. J. exp. Zool. 220: 1-10.

30. Harnish, D.G. and B.N. White 1982. An evolutionary model for the insect vitellins. J. Mol. Evol. 28: 405-413.

31. Harnish, D.G., G.R. Wyatt and B.N. White 1982. Insect vi-tellins: Identification of primary products of translation. J. exp. Zool. 220: 11-19.

32. Hausman, S.J., L.M. Anderson and W.H. Telfer 1971. The depend-ence of *Cecropia* yolk formation *in vitro* on specific blood pro-teins. J. Cell Biol. 48: 303-313.

33. Jowett, T. and J.H. Postlethwait 1980. The regulation of yolk polypeptide synthesis in *Drosophila* ovaries and fat body by 20-hydroxyecdysone and a juvenile hormone analog. Develop. Biol. 80: 225-234.

34. Kambysellis, M.P. 1970. Compatibility in insect tissue trans-plantations. I. Ovarian transplantations and hybrid formation between *Drosophila* species endemic to Hawaii. J. exp. Zool. 175: 169-180.

35. Kelly, T.J. and W.H. Telfer 1979. The function of the follicu-lar epithelium in vitellogenic *Oncopeltus* follicles. Tiss. Cell 11: 663-672.

36. Koeppe, J.K. and S.E. Wellman 1980. Ovarian maturation in *Leucophaea maderae:* juvenile hormone regulation of thymidine uptake into follicle cell DNA. J. Insect Physiol. 26: 219-228.

37. Koeppe, J.K., K. Hobson and S.E. Wellman 1980. Juvenile hormone regulation of structural changes and DNA synthesis in the follicular epithelium of *Leucophaea maderae*. J. Insect Physiol. 26: 229-240.

38. Koeppe, J.K., G.E. Kovalick and M.C. LaPointe 1981. Juvenile hormone interactions with ovarian tissue in *Leucophaea maderae*. In: *Juvenile Hormone Biochemistry*. G.E. Pratt and G.T. Brooks, eds. Elsevier/North-Holland Biomedical Press, pp. 215-231.

39. Kunkel, J.G. and M.L. Pan 1976. Selectivity of yolk protein uptake: Comparison of vitellogenins of two insects. J. Insect Physiol. 22: 809-818.

40. Lange, A.B. and B.G. Loughton 1981. The selective accumulation of vitellogenin in the locust oocyte. Experientia 37: 273-274.

41. Mahowald, A.P. 1972. Oogenesis. In: *Developmental Systems: Insects* 1: 1-47. S.J. Counce and C.H. Waddington, eds. Academic Press, London.

42. Melius, M.E. and W.H. Telfer 1969. An autoradiographic analysis of yolk deposition in the cortex of the *Cecropia* moth oocyte. J. Morphol. 129: 1-16.

43. Murray, M.R. 1926. Secretion in the amitotic cells of the cricket egg follicle. Biol. Bull. 50: 210-235.

44. Netzel, H. 1968. Die Auspragung non Polaritat und Bilateral symmetrie in den Oocyten von *Gryllus domesticus* L. Roux Archiv Entwicklungsmechanik 160: 119-166.

45. Nijhout, M.M. and L.M. Riddiford 1976. Juvenile hormone and ovarian growth in *Manduca sexta*. Am. Zool. 16: 198.

46. Ono, S., H. Nagayama and K. Shimura 1975. The occurrence and synthesis of female- and egg-specific proteins in the silkworm, *Bombyx mori*. Insect Biochem. 5: 313-329.

47. Pan, M.L., W.J. Bell and W.H. Telfer 1969. Vitellogenic blood protein synthesis by insect fat body. Science 165: 393-394.

48. Postlethwait, J.H. and P.D. Shirk 1981. Genetic and endocrine regulation of vitellogenesis in *Drosophila*. Amer. Zool. 21: 687-700.

49. Roth, T.F. and K.R. Porter 1964. Yolk protein uptake in the oocyte of the mosquito *Aedes aegypti* L. J. Cell Biol. 20: 313-332.

50. Roth, T.F., J.A. Cutting and S.B. Atlas 1976. Protein transport: a selective membrane mechanism. J. Supramol. Struc. 4: 527-548.

51. Sams, G.R., W.J. Bell and R.F. Weaver 1980. Vitellogenin: Its structure, synthesis and processing in the cockroach *Periplaneta americana*. Biochim. Biophys. Acta 609: 121-135.

52. Snodgrass, R.E. 1935. In: *Principles of Insect Morphology*. McGraw-Hill, New York, pp. 550-580.

53. Srdic, Z., C. Reinhardt, H. Beck and H. Gloor 1979. Autonomous yolk protein synthesis in ovaries of *Drosophila* cultured *in vivo*. Wilhelm Roux Arch. Develop. Biol. 187: 255-266.

54. Tata, J.R. and D.F. Smith 1979. Vitellogenesis: A versatile model for hormonal regulation of gene expression. Rec. Progr. Hormone Res. 35: 47-95.

55. Telfer, W.H. 1960. The selective accumulation of blood proteins by the oocytes of saturniid moths. Biol. Bull. 118: 338-351.

56. Telfer, W.H. 1961. The route of entry and localization of blood proteins in the oocytes of Saturniid moths. J. biophys. biochem. Cytol. 9: 747-759.

57. Telfer, W.H., E. Rubenstein and M.T. Klein 1976. Intrafollicular protein secretion during vitellogenesis in *Hyalophora cecropia*. *XVth Internat. Congr. Ent. Washington, Poster Session*.

58. Telfer, W.H. 1979. Sulfate and glucosamine labelling of the intercellular matrix in vitellogenic follicles of a moth. Wilhelm Roux Arch. Develop. Biol. 185: 347-362.

59. Telfer, W.H., personal communication via paper: "Experiments with vitellogenin in *Hyalophora* and *Manduca*". Symposium: Vitellogenin: Gene Structure, Biosynthesis and Uptake. *Joint Meeting of the Entomol. Soc. Amer., Entomol. Soc. Can. and Entomol. Soc. Ontario*, Toronto, 1982.

60. Telfer, W.H. and M.E. Melius 1963. The mechanism of blood protein uptake by insect oocytes. Am. Zool. 3: 185-191.

61. Telfer, W.H. and D.S. Smith 1970. Aspects of egg formation. Symp. Roy Ent. Soc. Lond. 5: 117-134.

62. Wallace, R.A. and E.W. Bergink 1974. Amphibian vitellogenin: Properties, hormonal regulation of hepatic synthesis and ovarian uptake, and conversion to yolk proteins. Am. Zool. 14: 1159-1176.

63. Warren, T.G. and A.P. Mahowald 1979. Isolation and partial chemical characterization of the three major yolk polypeptides from *Drosophila melanogaster*. Develop. Biol. 68: 130-139.

64. Warren, T.G., M.D. Brennan and A.P. Mahowald 1979. Two processing steps in maturation of vitellogenin polypeptides in *Drosophila melanogaster*. Proc. Natl. Acad. Sci. USA 76: 2848-2852.

65. Wigglesworth, V.B. 1972. In: *The Principles of Insect Physiology*. Chapman and Hall, London, pp. 700-764.

66. Wyatt, G.R. and M.L. Pan 1978. Insect plasma proteins. Ann. Rev. Biochem. 47: 779-817.

67. Wyss-Huber, M. and M. Luscher 1972. *In vitro* synthesis and release of proteins by fat body and ovarian tissue of *Leucophaea maderae* during the sexual cycle. J. Insect Physiol. 18: 689-710.

68. Wyss-Huber, M. and M. Luscher 1975. Protein synthesis in fat body and ovary of the physogastric queen of *Macrotermes sybhyalinus*. J. Insect Physiol. 21: 1697-1704.

69. Yasko, S., T.F. Roth and T. Smith, 1981. Receptor-mediated vitellogenin binding to chicken oocytes. Biochem. J. 200: 43-50.

Note added to proof:

After the preparation of this manuscript, a superb review of the cell biology of vitellogenic insect follicles appeared (Telfer, W. H., E. Huebner, and D. S. Smith, 1982. In: *Insect Ultrastructure* 1: 118-149. R. C. King and H. Akai, eds. Plenum Press, New York). This review, profusely illustrated with scanning and transmission electron micrographs, provides detailed analyses of two different mechanisms by which intercellular spaces in the follicular epithelium of vitel-logenic follicles are maintained and of the receptor and membrane recycling which must accompany the uptake of VG by receptor-mediated endocytosis. The potential for intercellular communication between adjacent follicle cells and follicle cells and oocytes through gap junctions is also thoroughly discussed.

Notes

THE JOURNAL

OF THE

ALABAMA ACADEMY
OF SCIENCE

AFFILIATED WITH THE
AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE

Publication and Subscription Policies

   Submission of Manuscripts. Submit all manuscripts and pertinent correspondence to the EDITOR. Each manuscript will receive two simultaneous reviews. For style details, follow Instruction to Authors (see inside back cover).

   Reprints: Requests for reprints must be addressed to authors.

   Subscriptions and Journal Exchanges: Address all correspondence to the CHAIRMAN OF THE EDITORIAL BOARD.

CONTENTS

LETTERS

THE *JOURNAL* FORMAT
CONTINUES TO CHANGE

The letters section in this issue introduces two new Associate Editors of the *Journal of the Alabama Academy of Science*. Their efforts will soon result in important new changes in the *Journal's* style. These editors will need the support of all Academy members.

You will note that this issue of the *Journal* contains six research articles. If we are to realize even a small degree of our potential, every member of the Academy should provide support and encouragement to potential contributors. Let me remind you that Instructions to Authors are printed inside the back cover of each issue.

A special need now exists in regard to the new cover format. Contributors of full-length articles are encouraged to submit photographs for possible use on the cover. However, any 2 x 2, 35-mm slide will be considered. The subject matter should be oriented parallel to the long axis of the slide. A short descriptive paragraph of the subject should accompany each submission. A brief biographical sketch of the contributor is also required (see recent issues).

Editor

Message from the Associate Editor for the Current Status of Science and Science Education in Alabama

I am excited about the new format of the *Journal* and I feel privileged to be able to play a part in this dynamic change. As you probably know, the editorial committee of the *Journal* recently decided to add a broader perspective to the *Journal* by including articles that are related to the "general interest" of the wide spectrum of our readers, and to appoint an Associate Editor to coordinate this function. Being that I have elected to undertake this role, I am now calling upon you to assist me in identifying areas in which you would like to be better informed. I will also welcome suggestions as to individuals who might like to write in these areas. Please feel free to write/call/inquire/inform me as to your preferences, or better yet, send me manuscripts.

I presently have articles in the "works" that will focus on some of Alabama's unique research facilities, articles dealing with the exploding field of computers, as well as articles that will retrospectively and prospectively reflect on science in general in Alabama. I would like to reiterate--this is your journal. We are attempting to make the *Journal* more readable, but it will take your input to make it successful. I am optimistic that we can continue to make the *Journal* interesting as well as informative.

Ken Francis
Associate Editor
RM. B41, RTI Building
University of Alabama
  in Birmingham
University Station, AL 35294
(205) 934-3566

Message from the Associate Editor for Business Affairs

The Alabama Academy of Science at its 1983 annual meeting es-

tablished the position of Associate Editor of Business Affairs for the purposes of promoting and overseeing advertisement in the *Journal of the Alabama Academy of Science*. Plans are now being developed to seek advertisement for the back cover, inside covers, and additional pages in the *Journal*, depending upon our success in obtaining advertisers.

It is hoped that the advertisements will serve as an additional source of revenue for the Academy, and also provide publishers, scientific supply companies, and others, the opportunity to promote products of interest to the readers of the *Journal*. The success of this advertising endeavor will depend to a great extent on your assistance in identifying potential advertisers. Please forward the names of possible advertisers, including addresses, telephone numbers, and if available, a representative of the company who could be contacted.

Thank you for your assistance and support of the Academy.

Curt M. Peterson
Associate Editor for Business
    Affairs
Department of Botany, Plant
    Pathology, and Microbiology
Auburn University, AL 36849
(205) 826-4830

Congratulations!

The new *Journal* format is a welcome change from the previous austere issues. With the full-color cover, I feel more inclined to leave the *Journal* on my desk where it will catch the eye of potential Academy members.

I must agree with Dr. Williams' suggestion to initiate a campaign for new members. The non-institutional sector is under represented in the Academy,

and yet this group has a wealth of practical knowledge to share. Also, I feel strongly that the Academy has a potential for significant input into the governmental and commercial sectors that would be to the benefit of Alabama.

I will be looking forward to the next issue.

Wayne R. Glass
Program Director
Solid Waste Disposal Authority
Opelika, AL 36802

RELATIONSHIP BETWEEN HEART ENZYMES AND AGE IN THE RAT[1]

Geraldine M. Emerson and William J. Wingo
*Department of Biochemistry and the Center
for Aging, Medical Center, the
University of Alabama in Birmingham
Birmingham, Alabama 35294*

For more than forty years, cardiovascular disease has been the leading cause of death in the United States, accounting for 51.2% of all deaths in 1980 (19). In the last 10 years Alabama moved from an average up to the group with the highest mortality rate for coronary heart disease. Even though the death rate has been declining for all causes, diseases involving the heart and blood vessels still account for 1.84 times as many deaths as the next most frequent cause (malignant neoplasms). More than half of deaths due to heart disease occur in persons sixty-five years of age or older. Of the 35,305 deaths due to all causes in the State of Alabama in 1980, 16,155 (45.8%) were related to cardiovascular disease; 5,501 of these, just over one-third, were due to myocardial infarction (interference with blood flow to the heart tissue); many of the rest were a consequence of some more extended process occurring in the myocardium. A number of changes have been reported to occur in the myocardium as aging proceeds. These include: (1) a progressive reduction in the rate of vascular perfusion of the heart; (2) accumulation of the so-called aging pigments and amyloid; and (3) alterations in the proportions of connective tissue to muscular tissue. These changes must be accompanied by differences in biochemical states between myocardia of younger and of older individuals. Previous reports indicate that laboratory rats have an appreciable incidence of myocardial disease. Approximately 50% of our laboratory rats dying without intervention have primary heart disease (10). Berg and Simms did a series of studies concerned with the pathology of old rats. In one report (5) microscopically determined lesions of the myocardium ("myocardial degeneration") of rats of both sexes and for ages predominantly 600 days and above ranged in incidence from 25% to almost 100%.

A number of studies (1, 4, 8, 11, 14, 15, 16, 23) have been made to ascertain biochemical differences between myocardia of younger and of older animals. In many cases the "old" groups were composed of at best middle-aged adults, so that any changes observed could have been maturational (those changes occuring from conception through childhood and adolescence until the mature young adult status is achieved). By using a number of groups covering the whole age span of the species, it should be possible to detect maturational changes as well as eugerial changes (those occuring predictably at a specific adult age, with only minor deviations in all or almost all individuals of a given species, e.g. humans, the development of presbyopia

---

and the female climacteric). Pathogeric changes (those present in old age caused by microbial or other environmental insults to the organism) could also be detected.

Insight into the bases of these changes should occur through data gathered in studies such as the one reported here. Five enzymatic activities were determined on cardiac mitochondrial fractions. Four of the enzymes: cytochrome oxidase (E.C.1.9.3.1., Cy Ox), succinate dehydrogenase (E.C.1.3.99.1,SDH), betahydroxybutyrate dehydrogenase (E.C.1.1.1.30,BDH), and glutamate dehydrogenase (E.C.1.4.1.2, GDH), were chosen because they are directly involved in cellular energy transductions. Glutamate-oxaloacetate transaminase (E.C.2.6.1.1, GOT), was chosen because of its importance in "preparing" amino acids for catabolism and therefore leading into the cellular energy transduction pathways.

MATERIALS AND METHODS

Approximately equal numbers of male and female rats, totaling 166, drawn from a 20-year closed colony established from Long-Evans stock served as subjects for these experiments which were conducted over a period of four years. The rats ranged in age from 11 days to 1,088 days.[2] Composition of the groups appears in Table I.

TABLE I. Grouping of Rats by Age

GROUP NUMBER	NUMBER OF RATS	MEAN AGE (days) + Standard Error
1	27	62 ± 4
2	19	134 ± 5
3	21	230 ± 6
4	18	319 ± 7
5	12	415 ± 8
6	15	511 ± 6
7	11	599 ± 7
8	14	691 ± 9
9	9	773 ± 8
10	8	864 ± 6
11	7	946 ± 10
12	5	1050 ± 16

These rats were not Caesarean delivered nor barrier sustained but they were maintained in a "clean room" in which constant light-dark cycles and temperature prevailed. A standard lab chow and drinking water were constantly available. During the history of the colony only a few epizootics of infectious disease occurred.

---

[2]The comparable human age span is one year to 100 years.

Animals were selected for experiments at random. However, for a given day's experiment the selection of the animal was made so that the sex ratio of the total group was kept close to one, as well as maintaining an essentially constant proportion among the age groups. This process should have minimized differences among the groups occasioned by environmental perturbations.

Each animal was lightly anesthesized with ether and decapitated. The heart was removed and quenched in ice cold Chappell-Perry medium (9). The myocardium was weighed, minced finely with scissors and homogenized in a ten-fold quantity (w/v) of ice-cold Chappell Perry medium, at zero to 4° centrigrade. The "mitochondrial fraction" was isolated by differential centrifugation in Chappell-Perry medium according to standard procedures (17). The final pellet was suspended in 0.25 M sucrose. The protein content of the final suspension was determined by the method of Lowry et al.(20). Aliquots of the suspension were diluted appropriately with water to yield the desired protein concentration and twice frozen and thawed to disrupt the mitochondria and release the enzymes. The disrupted suspension was assayed for:

1. Cytochrome Oxidase by the method of Wharton and Griffiths (26). (The initial rate of change of absorbance at 550 nm was determined.)

2. Succinate Dehydrogenase by the method of Baginski and Hatefi (2).

3. Glutamate Dehydrogenase by the method of Tomkins et al. (25).

4. Beta-hydroxybutyrate Dehydrogenase by a method worked out by the authors (12).

5. Glutamate - Oxaloacetate Transaminase by the Bergmeyer and Bernt method (6).

In addition, aliquots of intact mitochondria from each rat's heart were subjected to oxygen polarographic measurement of oxygen utilization rates to assure that "respiring" mitochondria had actually been obtained. Our procedure for calibration of the oxygen polarograph has been reported (27). In the few cases where electron micrographs of these mitochondrial suspensions were examined, the mitochondrial morphology appeared normal and contamination by other intracellular organelles was minimal.

The data were analyzed by comparing the mean value for one of the twelve groups with the mean of each of the other groups for each of the enzymatic activities. Based upon the Student t test, we accepted a difference as significant only at a probability of one out of one-hundred or less ($P \leq .01$). Male and female data were combined since we had previously found that there was no significant difference between the sexes for these five heart enzyme activities (12).

RESULTS AND DISCUSSION

The results appear in Figures 1, 2, 3 and 4.

Perhaps the most interesting results are those for succinate dehydrogenase (Fig. 1) and cytochrome oxidase (Fig. 2). The specific activities of succinate dehydrogenase are remarkably constant throughout the lifespan in that the mean activity for no group of rats is significantly different[3] from that of any other.
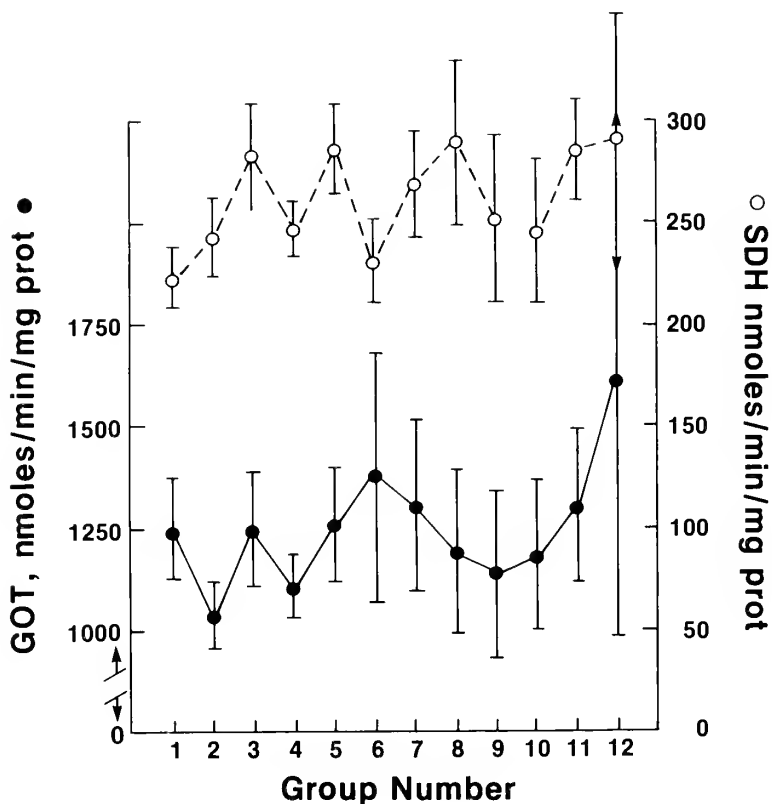
Fig. 1   GOT and SDH Activities
         The line extends one standard error above or below the mean
         value.
         For ages of the rats in each group see Table 1.

_____

[3]While not ruling out the possibility of differences at a less con-
servative level, we feel confident of the difference at the 1% proba-
bility level ($P \leq 0.01$) criterion used throughout this paper.
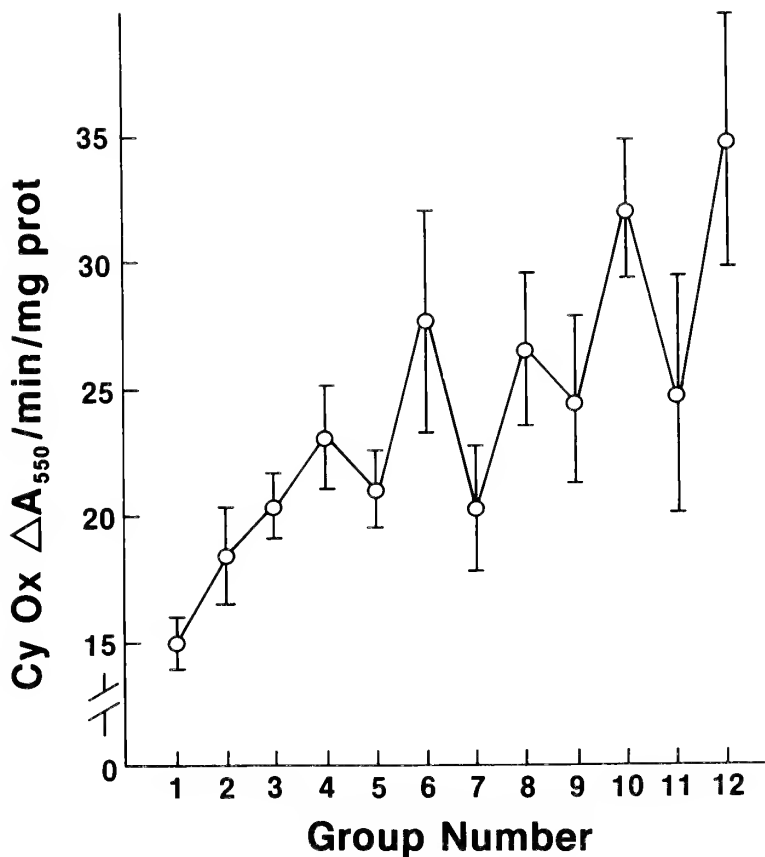
Fig. 2   Cytochrome Oxidase Activity

The lines extend one standard error above or below the mean value.

For ages of the rats in each group see Table 1.

Succinate dehydrogenase is the only oxidoreductase of the citrate cycle which we measured and is the only one with a riboflavin prosthetic group. Our findings that this SDH activity is not significantly different at any of the ages measured indicates that since these rats were on a constant diet from weaning the vitamin precursor of the prosthetic group riboflavin, was present in sufficient amount
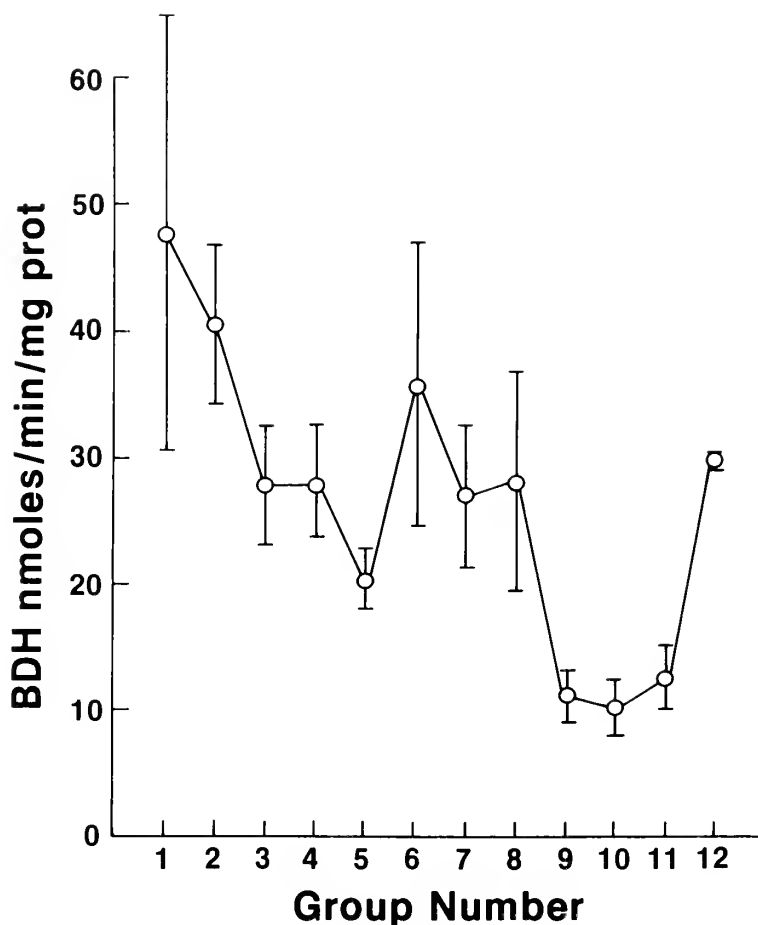
Fig. 3 Beta-hydroxybutyrate Dehydrogenase Activity

The line extends one standard error above or below the mean.

For ages of the rats in each group see Table 1.

in the diet for each and every age. Therefore the potential for electron flow through the reaction catalyzed by SDH does not change in the heart through the rat lifetime. Consistently we have found that SDH activity is high in the rat heart. The literature has diverse findings for SDH activities of the heart. This disparity could arise from the measurement in some cases of the respiratory chain from SDH all the way to oxygen; in other cases perhaps a less conservative criterion for differences was used.
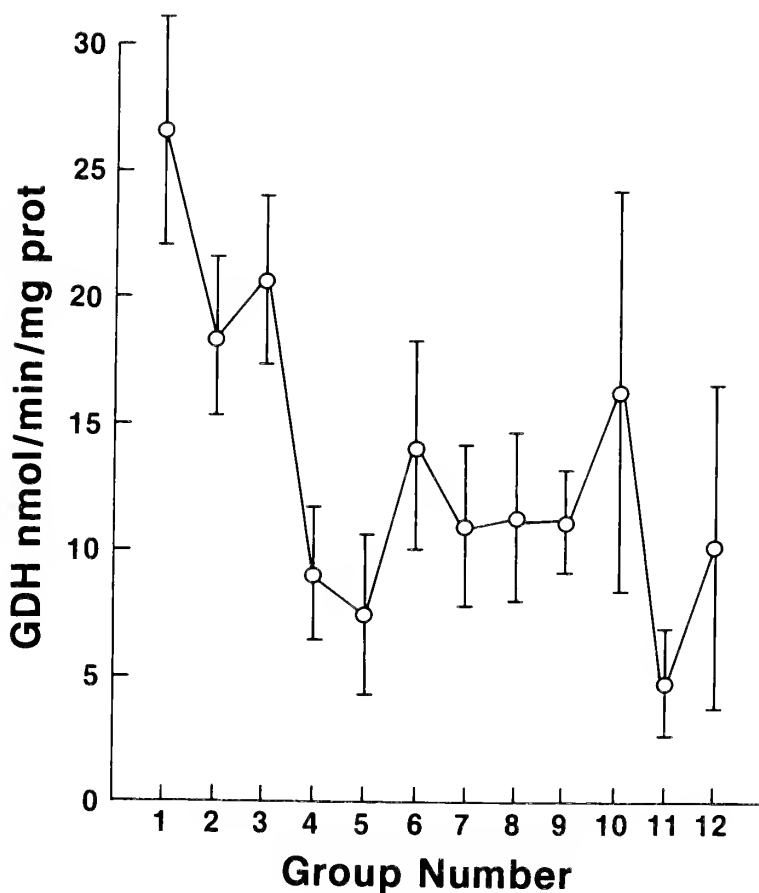
Fig. 4 Glutamate Dehydrogenase Activity

The line extends one standard error above or below the mean.

For ages of the rats in each group see Table 1.

Qualitative studies on a number of isozymes including isocitrate dehydrogenase and malate dehydrogenase performed by Schmukler and Barrows (22) showed no change in the heart with age when 365 day old rats were compared with 730 day old rats. Neither was a quantitative difference found in heart malate dehydrogenase with age. These integral oxidoreductases of the citrate cycle have the same age pattern of activity as the one we measured - SDH.

Even though the activity of GOT (Fig. 1) showed much individual variation, there was no significant difference between any of the groups. This indicates that the potential for entry of carbon atoms from amino acids to other metabolic pathways is as great in the oldest as in any other age group. As a point of clinical interest since GOT is often measured in the serum following myocardial infarction, the fact that its activity does not change with age makes it a good choice in this regard. Strandjord and Claysen (24) followed a patient from the time of myocardial infarction and found that BDH rose at the same time as GOT but that the serum BDH remained elevated longer.

The findings in regard to cytochrome oxidase are quite different. Cytochrome oxidase (Fig. 2) activity has an upward trend throughout the lifespan. Significant differences were found in the first 319 days of life (this corresponds to an approximately equivalent age in man from birth to 30 years). The intervening ages up to 864 days (approximately equivalent to 76 years in man) have much variability among the groups and are not significantly different from each other. This variability may be a reflection either of genetic differences among these rats or of pathogenic changes. Other investigators (13,21) have noted and been at a loss to explain analogous variations in their intermediate groups as contrasted with the young. Survivors into old age have again significantly higher cytochrome oxidase activity. Comparison of our findings in the normal rat with those of Bajusz (3) in a strain of Syrian hamsters with hereditary cardiomyopathy should be revealing. By histochemical means Bajusz found no change in the intact fibers even in failing hearts but found a decrease in both cytochrome oxidase and succinate dehydrogenase activities of fibers whose integrity was lost. Perhaps a number of our rats had sufficient fiber damage to lower the mean for the intermediate groups. Current techniques do not permit both microscopic evaluation and biochemical analysis in the same rat heart. This could be done in species with larger hearts. It is tempting to speculate that the rise in cytochrome oxidase activity in old age may be a response to a lowering in the rate of delivery of oxygen to the mitochondria through a lowering of the rate of vascular perfusion of the myocardium; accumulation of lipofuscin; or other "wear and tear" phenomena. The elaboration of more cytochrome oxidase allows more efficient use of the oxygen available at the mitochondrial membrane.[4]

---

[4] In view of the known importance of myoglobin in oxygen transport in red muscle, we though that this component might also increase with age, since this would tend to increase the peri-mitochondrial oxygen concentration. Accordingly (28) we determined myocardial myoglobin content on two additional groups of rats: 267+ 6 days and 816 + 23 days of age. (Mean + standard error.) Although the absolute value of myoglobin per gram heart ventricles was higher in the younger group (2.9 + 0.1 vs 2.6 + 0.2) this is not significant (P=0.08). Burleigh and Schimke (8) found myoglobin to be 3.9 + 0.7 mg/g heart in Sprague-Dawley rats 42 days to 180 days of age. In the absence of intervening age data one cannot rule out a real decline in myoglobin concentration from 180 days of age to 267 days of age.

In Figures 3 and 4, graphs of the activities of BDH and GDH reveal a decrease in rat heart as a function of age. The significance of these changes is difficult to assess without further information. While it is known that the GDH activity of myocardium is less than that of either brain or liver (12), a decline in old age would further limit that activity so that the myocardial usage of amino acids for fuel or for gluconeogenesis should be smaller in the older groups. Indeed the heart of the old rat would be less adaptable than the young. Additional data are necessary in order to determine if there is a correlation between myocardial disease and this enzyme.

The significance of a decline in BDH activity would at first appear to put restriction on the flow of energy from lipid substrate into final catabolism to acetyl CoA and the citrate cycle of the heart. Others (16) have reported that BDH activity is decreased in the old rat liver. This could result in a decreased hepatic release of ketone bodies. The decreased activity in the heart could be a reflection of an adaptation to a decreased supply. Grinna and Barber (16) failed to find a decrease in the heart BDH activity of their 730 day Sprague-Dawley male (their older group) compared with their young group of 180 day old male rats.

In order to test these activities in our laboratory in another strain of rat, we obtained four old Sprague-Dawley male rats through Dr. Don C. Gibson, Health Scientist Administrator, National Institute of Aging. The results from the four Sprague-Dawley rats were not significantly different from the activities we found in five of our males of comparable age. These findings suggest that for animals surviving for more than 800 days, any differences which at earlier ages might be due to the environment, that is the conventional clean environment of our colony and the barrier environment of those Sprague-Dawley rats, are not reflected in the parameters measured.

It has been reported (18) that rat heart behaves differently from a number of other mammalian species in a number of functions involving ion fluxes and tension augmentation with heart rate (stimulatory rate). Perhaps one should use caution therefore in extrapolating the results we have found in the rat to other mammals, including man.

CONCLUSION

The results reported fall into the same category of responses which others have found in other species (7). The enzyme activities measured vary in unpredictable ways as a function of age. Sometimes even different strains of the same species have divergent enzyme activity changes as a function of age. Many questions remain. Until we are able to assign a physiological or biological age to an organism, we predict that one will continue to find great variability among the moderately long-lived members of the species when grouped solely by chronological age. The task remains to find a unifying basis for the aging process, to be able to understand the controlling

factors in these divergent or unpredictable changes in the absence of measurement, and to describe activities of enzymes catalyzing the reactions of intermediary metabolism over the adult lifespan.

LITERATURE CITED

1. Abu-Erreish, G.M. and R.D. Sanadi. 1978. Age-related changes in cytochrome concentration of myocardial mitochondria. *Mech. of Aging and Develop. 7*:425-432.

2. Baginski, M.L. and Y. Hatefi. 1969. Reconstitution of succinate-Coenzyme Q reductase (complex II) and succinate oxidase activities by a highly purified, reactivated succinate dehydrogenase. *J. Biol. Chem.* 244: 5313-5319.

3. Bajusz, E. 1969. Hereditary cardiomyopathy: A new disease model. *American Heart Journal* 77:686-696.

4. Barrows, C.H., M.J. Yiengst and N.W. Shock. 1958. Senescence and the metabolism of various tissues of rats. *J. Gerontol. 13*: 351-355.

5. Berg, B.N. and H.S. Simms. 1960. Nutrition and longevity in the rat. II. Longevity and onset of disease with different levels of food intake. *J. Nutrition 71*: 255-263.

6. Bergmeyer, H.U. and E. Bernt. 1963. *Methods in Enzymatic Analysis*, edited by H.U. Bergmeyer, New York, Academic Press, p. 837.

7. Birnbaum, L.S. 1980. Altered hepatic drug metabolism in senescent mice. *Exp. Gerontol. 15*: 259-267.

8. Burleigh, I.G., and R.T. Schimke. 1969. The activities of some enzymes concerned with energy metabolism in mammalian muscles of differing pigmentation. *Biochem. J. 113*: 157-166.

9. Chappell, J.B. and S.B. Perry. 1954. Biochemical and osmotic properties of skeletal muscle mitochondria. *Nature 173*: 1094-1095.

10. Emerson, G.M. and J.D. Emerson. 1966. Effect of long term androgen-estrogen therapy on life span of the female rat. *J. Ala. Acad. Science 37*: 371-372.

11. Emerson, G.M. and W.J. Wingo. 1977. Myocardial oxidative functions during rat lifespan. *Fed. Proc. 36*: 293.

12. Emerson, G.M. and W.J. Wingo. 1977. Relative activities of some enzymes of rat brain, heart, and liver mitochondria. *Ala. J. Med. Science 14*: 410-414.

13. Finch, C.E. 1972. Enzyme activities, gene function and ageing in mammals. *Exp. Geront. 7*: 53-67.

14. Geary, S., and J.R. Florini. 1972. Effect of age on rate of protein synthesis in isolated perfused mouse hearts. *J. Gerontol. 27*: 325-332.

15. Gold, P.H., M.V. Gee, B.L. Strehler. 1968. Effect of age on oxidative phosphorylation in the rat. *J. Gerontol. 23*: 509-512.

16. Grinna, L.S. and A.A. Barber. 1972. Age-related changes in membrane lipid content and enzyme activities. *Biochim. Biophys. Acta 288*: 347-353.

17. Johnson, D. and Lardy, H. 1967. Isolation of liver or kidney mitochondria. pp 94-96. *Methods in Enzymology*, Vol. 10 edited by S.P. Colowick and N.O. Kaplan, Academic Press, New York.

18. Langner, G.A. and Brady, A.J. Eds. 1974. *The Mammalian Myocardium*, John Wiley and Sons, New York. p. 204.

19. Levy, R.I. and J. Moskowitz. 1982. Cardiovascular research: decades of progress a decade of promise. *SCIENCE 217*: 121-129.

20. Lowry, O.H., N.J. Rosenbrough, A.L. Farr, and R.J. Randall. 1951. Protein measurement of the folin phenol reagent. *J. Biol. Chem. 193:*265-275.

21. Robertson, I.G.C. and L.S. Birnbaum. 1980. Changes in mutagen activation with senescence in rat tissues. *Age 3*: 107.

22. Schmukler, M. and C.H. Barrows. 1967. Effect of age on dehydrogenase heterogeneity in the rat. *J. Gerontol. 22*: 8-13.

23. Sordahl, L.A. 1976. Differences in mitochondrial functions from right and left ventricular myocardium of four mammalian species. *Comp. Biochem. Physiol. 54B*: 339-342.

24. Strandjord, P.E. and K.J. Clayson. 1974. Clinical enzymology in the evaluation of heart and liver disease. *Enzymology in Medicine* P. Blume and E.F. Freir, Eds. Academic Press, New York.

25. Tomkins, G.M., K.L. Yielding, J.R. Curran, M.R. Summers, and M.W. Bitensky. 1965. The dependence of the substrate specificity on the conformation of crystalline glutamate dehydrogenase. *J. Biol. Chem. 240*: 3793-3798.

26. Wharton, D.C. and D.E. Griffiths. 1962. Studies on the electron transport system. *Arch. Biochem. Biophys. 96*: 103-114.

27. Wingo, W.J. and G.M. Emerson. 1975. Calibration of oxygen polarographs by catalase-catalyzed decomposition of hydrogen peroxide. *Anal. Chem. 47*: 351-352.

28. Wingo, W.J. and G.M. Emerson. 1980. Myocardial myoglobin as a function of age. *Age 3*: 114.

AN *IN VIVO* AND *IN VITRO* EVALUATION OF THE EFFECT OF CHLORAL HYDRATE
ON MITOSIS IN RAT EPITHELIAL TISSUES[1,2]

Jerry L. Boshell, D.M.D., Ph.D.
Department of Orthodontics
School of Dentistry
Medical College of Georgia
Augusta, Georgia 30912
and
George S. Schuster, D.D.S., Ph.D.
Department of Oral Biology/Microbiology
School of Dentistry
Medical College of Georgia
Augusta, Georgia 30912

ABSTRACT

The *in vivo* potential of chloral hydrate at an anesthetic dose
to inhibit mitoses in rat lingual and salivary gland epithelium was
evaluated. In addition, tissue slices of salivary glands were incu-
bated *in vitro* in media containing chloral hydrate at either 6.5 x
10^{-3}M, 6.5 x 10^{-2}M or 6.5 x 10^{-1}M. *In vivo*, no suppression of
mitosis was seen eight hours after injection. *In vitro*, only at the
highest concentration of chloral hydrate was suppression observed.
This *in vitro* suppression could be due to cellular toxicity of
chloral hydrate at that concentration.

INTRODUCTION

For some time our laboratory has used aqueous chloral hydrate
for anesthesia during surgical procedures on laboratory rats. The
rats appear to tolerate the intraperitoneal injections well and few
deaths occur during surgery. Furthermore, with the concentrations
used, the duration of anesthesia is shorter than with other commonly
used agents.

Reports have indicated that chloral hydrate has the potential to
interrupt mitosis (Deysson 1968, Ates and Sentein 1978). Since the
surgical procedures are for studies of salivary gland and tongue
epithelium regeneration, we felt it important to evaluate the effect
of an anesthetic dose of chloral hydrate on the mitotic rate in
normal non-surgerized tissues and to compare the effects *in vitro* of
concentrations of chloral hydrate used in earlier studies (Ates and
Sentein 1978).

This report describes the *in vivo* and *in vitro* effect of chloral hydrate on epithelial cell division in these tissues.

MATERIALS AND METHODS

Weaned, three week old male and female Sprague-Dawley rats were used. At this age acinar cells in both the parotid and submandibular glands are undergoing postnatal cell division (Young and Van Lennep 1978) and in addition, tongue basal epithelium has a constant turnover (Cutright and Bauer 1967).

In Vivo: Rats were given intraperitoneal injections of chloral hydrate (Fisher) (200 mg/kg body weight) dissolved in saline, whereas negative control animals were injected with the appropriate volume of saline. For a positive control, another group was given intraperitoneal injections of colchicine (Sigma) (2 mg/kg body weight) dissolved in saline. After 8 hours the rats were killed by cervical dislocation, and the tongue, submandibular and parotid glands were removed and fixed with 10% Millonig's buffered formalin (Carson 1973).

In Vitro: A total of 12 male and female rats was killed by cervical dislocation and the submandibular and parotid glands were removed. The glands were sliced with a Stadie-Riggs tissue slicer and the slices were placed in 10 ml of Waymouths 752/1 medium supplemented with 5% fetal calf serum (Flow). For experimental groups chloral hydrate was added to the media in the following concentrations: 6.5×10^{-3}M, 6.5×10^{-2}M and 6.5×10^{-1}M (Ates and Sentein 1978). For a positive control, colchicine was added to one group at 2×10^{-3} (Ates and Sentein 1978). The tissues were incubated at 37°C in an atmosphere of 95% air and 5% CO_2 for 8 hours. All the tissues was subsequently fixed with 10% Millonig's buffered formula.

After fixation for 48 hours, the tissues were dehydrated in graded alcohols at room temperature, cleared in xylene and embedded in paraffin. Sections 6 μm thick were cut, collected on glass slides and alternate slides were stained with hematoxylin and eosin (H&E). The H&E stained sections were used to count a total of 3,000 cells per group in both the *in vivo* and *in vitro* experiments. Acinar cells were counted in parotid and submandibular glands, whereas basal epithelial cells were counted in tongue epithelium. Mean numbers of mitotic figures per 3000 cells for each group were calculated and compared using Student t-test.

RESULTS

In Vivo: The histological appearance of the three epithelia in either the control or experimental animals was similar. Moreover, the mean number of mitotic figures did not vary significantly between saline and chloral hydrate treated animals. However, colchicine treated control cells did show a significantly greater number of mitotic figures than either experimental or saline treated tissue (Table 1).

TABLE I

Mean Number of Mitotic Figures Per 3000 Cells *In Vivo*

	Tongue	Parotid Gland	Submandibular Gland	No. of Animals
Saline	15.7 ± 4.2[a]	8.7 ± 4.2	1.7 ± 0.6	3
Chloral Hydrate 200 mg/kg	13.3 ± 2.5	11.3 ± 6.7	2.7 ± 0.6	3
Colchicine 2 mg/kg	112.3 ± 31.6*	109.7 ± 45.2*	22.3 ± 11.0*	3

[a]Mean ± Standard Deviation

*Significant at .05 level

In Vitro: After 8 hours incubation, cells at the periphery of the salivary tissue slices were consistently judged to be viable. Therefore, counts were made of these peripheral acini. As shown in Table 2, the number of mitotic figures per 3000 cells *in vitro* was lower than *in vivo* for both submandibular and parotid gland tissue. In contrast to the *in vivo* experiment, the mean number of mitotic figures differed significantly from saline control tissue only at 6.5 x 10^{-1}M. Other concentrations of chloral hydrate showed no significant differences from controls. With colchicine treatment, only the parotid gland showed a significantly higher number of mitotic figures.

TABLE II

Mean Number of Mitotic Figures Per 3000 Cells *In Vitro*

	Parotid Gland	Submandibular Gland
Control	1.7 ± 0.6[a]	2.7 ± 2.1
Chloral Hydrate 6.5 x 10^{-1}M	0.3 ± 0.6*	0.3 ± 0.2*
Chloral Hydrate 6.5 x 10^{-2}M	1.7 ± 1.5	2.0 ± 1.0
Chloral Hydrate 6.5 x 10^{-3}M	1.3 ± 1.5	1.0 ± 1.4
Colchicine 2 x 10^{-3}M	6.0 ± 3.0*	2.0 ± 2.8

[a]Mean ± Standard Deviation

*Significant at .05 level

DISCUSSION

The objective of the *in vivo* experiments was to determine whether the anesthesia producing concentrations of chloral hydrate interrupted mitoses in salivary glands and tongue epithelia of rats. This was not observed. *In vivo* the concentration of chloral hydrate in circulating blood, although of a level adequate to establish anesthesia, could have been insufficient to interrupt mitotic activity in the observed tissue since earlier reports suggested that the concentration of the drug must be high, indeed near the toxic level in order to interrupt mitoses (Deysson 1968, Kennedy and Brittingham 1968). Such concentration insufficiency could be dependent on the dose administered or rate of metabolism and/or

excretion.   Another possibility is that the effects were of such
short duration and significance that mitoses had resumed by the time
of sampling.

Ates and Sentein (1978) clearly showed that chloral hydrate
disrupted microtubules *in vitro* in segmentation mitoses in newt.
Apparently certain criteria must be met in order for microtubule
disruption to occur *in vitro*.   The first is that the microtubules
must be labile, and there are different degrees of lability.   For
example, in *Paramecium caudatum* the tail microtubules are susceptible
to disruption at a level that does not affect those in oral cilia
(Kennedy and Brittingham 1968).   A second is drug concentration, and
as previously mentioned, the level of chloral hydrate must be near
toxic levels for a particular tissue.

Under certain conditions and in some tissues chloral hydrate can
interrupt mitoses; however, we found no evidence that at an anes-
thetic dose it does this in rat lingual or salivary gland epithelium.

LITERATURE CITED

Ates, Y. and P. Sentein.   1978.   A comparison between the actions of
    colchicine,   chloral hydrate, glutaraldehyde and phenylurethane
    on the ultrastructure of segmentation mitoses in a newt.
    Biologie Cellulaire 33: 129–136.

Carson, F.L.   1973.   Histologic   techniques   in   electron microscopy.
    Norelco Reporter 20: 8–14.

Cutright, D.E. and H. Bauer.   1967.   Cell renewal in the oral mucosa
    and   skin of the rat I.   Turnover time.   Oral Surg. 23: 249–259.

Deysson, G.   1968.   Antimitotic   substances.   Internat'l   Rev. Cytol.
    24: 99–148.

Kennedy, J.R., Jr. and E. Brittingham.   1968.   Fine structure changes
    during chloral hydrate deciliation of *Paramecium caudatum*.   J.
    Ultrastruct. Res. 22: 530–545.

Young, J.A. and E.W. Van Lennep.   1978.   *The Morphology of Salivary
    Glands*.   London: Academic Press.

ECONOMIC KNOWLEDGE AND ATTITUDES
TOWARD FCONOMIC ISSUES[1]

James F. Haynes
Department of Economics
Athens State College
Athens, Alabama 35611

ABSTRACT

Recent problems in the American economy have increased the interest in economic education. More attention has been placed on the need to improve the economic literacy of high school students. New curriculum programs have been created, but little attention has been given to assessing the outcomes of these programs. This study examined the knowledge and attitudinal consequences of the required semester course in economics taken by all twelfth grade students in Alabama. The experimental group contained 105 students who had taken economics during the fall term of 1981 and the control group contained 101 students who would take economics during the spring term. A posttest-only control-group design was utilized. At the end of the fall term both groups were given the Test of Economic Literacy and the Social Opinion Questionnaire. The TEL measured students' understanding of basic economic concepts and the SOQ assessed students' opinions about economic issues. High scores on the TEL indicate greater understanding of economic concepts and high scores on the SOQ indicate more conservative attitudes. A critical ratio was used to compare the mean scores for both groups on both instruments. The data revealed that students who had completed the economics course knew significantly more about economic concepts and help significantly more conservative attitudes toward economic issues than students who had not studied economics. In addition, significantly high positive correlation coefficients were obtained between scores on the TEL and SOQ for both groups.

INTRODUCTION

Inflation, unemployment, over-population, high interest rates, the energy shortage, and the increasing burden of taxation are some of the economic issues being discussed by many Americans. If Americans are to become better prepared to cope with these problems, they need to become more knowledgeable about basic economic principles and must be able to critically examine alternative policies designed to correct these short-comings in the economy.

Since only a small portion of all citizen-voters have taken and will be expected in the future to take as much as one economics course in college, Bach and Sauders (1965) stated that attention

---

should be increasingly focused on developing economic understanding through teaching the high schools. In recent years many new innovative programs for teaching economics in high school have been developed. The Joint Council on Economic Education has been instrumental in developing new curriculum materials and in encouraging additional course offerings in high school economics. Little attempt has been made, however, to assess the outcomes of these programs.

STATEMENT OF THE PROBLEM

Nobel Laureate economist George Stigler (1959) argued that the study of economics affects one's attitude towards economic issues. *Ceteris paribus*, he hypothesized that the education of an economist makes the person who receives it more conservative. Attitudes towards basic social goals depend heavily on an individual's perception of reality. The more economics one learns, the more likely a person is to adopt a perception of reality consistent with economic theory. If Stigler is correct in his belief that the training received by an economist makes the person receiving it more conservative, does even a limited exposure to the theoretical and empirical study of economics make the typical high school senior have a more conservative attitude toward economic issues?

NEED FOR ADDITIONAL RESEARCH

D. R. Lewis and C. C. Orvis (1971) stated that attempts to assess the extent to which instruction in economics changes student opinion (attitudes or values) on controversial issues are still in their infancy. Likewise, Howard P. Tuckman (1975) reported that student attitudes are changed in economics classes and that an effort should be made to measure the change. Similarly, George Dawson (1976) found that only a small percentage of studies in economic education have stressed student opinions and attitudes toward economic issues. Finally, John C. Soper (1977) reported that even though most economics teachers believe that economic education affects attitudes toward economic topics and issues, researchers have barely scratched the surface of the attitudinal dimensions of economic education evaluation.

THE CURRENT STUDY

This study examined the knowledge and attitudinal consequences of the one-semester required course in economics that is taken by all twelfth grade students in Alabama. The work was similar to previous studies involving college students conducted by Dawson (1966), Scott and Rothman (1975), Riddle (1978), and Sosin and McConnell (1979).

Three hypotheses were tested:

1. Students who have completed the one-semester required course in high school economics will know significantly more about basic economic concepts than students who have not taken such a course.

2. Students who have completed the one-semester required course in high school economics will have significantly more conservative attitudes toward economic issues than students who have not taken such a course.

3. There will be significant relationship between a high level of economic understanding and conservative attitudes toward economic issues for students who have and have not taken the required one-semester course in high school economics.

Research Design and Instrumentation

The sample for the study consisted of twelfth grade students at Grissom High School in Huntsville, Alabama. The experimental group contained 105 students who had taken the one-semester required course in economics during the fall semester of 1981. The control group contained 101 students who would take the same course during the spring of 1982. The two groups were identical except for the economics instruction.

A posttest-only control-groups design, recommended by Campbell (1975) for attitudinal studies, was utilized. At the end of the fall semester of 1981, both groups were given the Test of Economic Literacy developed by the Joint Council on Economic Education and reported on by Soper (1979). This forty-six question multiple choice test was used to measure the students' understanding of basic economic concepts. In addition, both groups of students were given the seventeen-item version of the Social Opinion Questionnaire developed by two economists, Scott and Rothman (1975). A five choice Likert-type scale from "strongly agree" (5 points) to "strongly disagree" (1 point) is used to record student reaction to statements dealing with economic issues. For scoring purposes, Scott and Rothman gave each item a weight of less than one, by which each response is multiplied in order to calculate a student's score on the opinion scale. This instrument was used to assess the students' opinions concerning economic issues along a liberal-conservative dimension.

The dependent variables were the posttest scores for both groups on the two instruments. High scores on the TEL indicate greater understanding of basic economic concepts and high scores on the SOQ represent "more conservative" attitudes toward economic issues. The independent variable was the required one-semester course in high school economics.

Statistical Analyses

A critical ratio or t test was used to determine if there was a significant statistical difference between the mean scores of the experimental group and those of the control group on both the TEL and SOQ. In addition, product moment correlation coefficients were calculated between the scores on the two instruments for both groups.

Findings

Table 1 shows the mean, standard deviation, and t value for the difference in mean scores on the TEL. Table 2 shows the mean, standard deviation, and t value for the difference in mean scores on the SOQ. Table 3 shows the correlation coefficient between scores on the TEL and SOQ for both groups. With respect to the first hypothesis, the t value indicates that the mean score of the experimental group was significantly higher at the .01 level than the mean score of the control group. Students who had completed the required economics course understood, on the average, more about basic economic concepts than those who had not taken the course. With respect to the second hypothesis, the t value shows that the mean score on the SOQ for the experimental group was significantly higher at the .05 level than the mean score of the control group. Students who had taken the required economics course, on the average, held more conservative opinions toward economic issues than students who had not studied economics. With respect to the final hypothesis, the two coefficients indicate that there was a significant direct relationship at the .05 level between scores on the TEL and SOQ for both the experimental and control groups. In both groups, students who knew more about basic economic concepts, on the average, had more conservative attitudes toward economic issues than those who understood less about economic concepts.

TABLE 1

MEAN, STANDARD DEVIATION, AND t VALUE FOR THE TEL

GROUP	MEAN	STANDARD DEVIATION	t VALUE
Control	20.6535	6.090	-6.45*
Experimental	26.4571	6.792	

*Significant at the .01 level

TABLE 2

MEAN, STANDARD DEVIATION, AND t VALUE FOR THE SOQ

GROUP	MEAN	STANDARD DEVIATION	t VALUE
Control	-3.6193	4.220	-2.01*
Experimental	-2.4976	3.788	

*Significant at the .05 level

TABLE 3

CORRELATION COEFFICIENTS FOR THE TEL AND SOQ

GROUP	MEAN	STANDARD DEVIATION	COEFFICIENT
Control			
TEL	20.6535	6.090	.4557*
SOQ	-3.6193	4.220	
Experimental			
TEL	26.4571	6.792	.4661*
SOQ	-2.4976	3.788	

*Significant at the .05 level

Conclusion

Subject to the limitations of time and the number of students involved, this study seems to indicate that the required one-semester course in high school economics can effectively increase Alabama students' understanding of basic economic concepts. In addition, the findings of this study tend to be consistent with the hypothesis that even a limited exposure to the study of economics may affect student opinions and attitudes toward economic issues. Finally, it appears that there may be a relationship between economic knowledge and attitudes towards economic issues.

Two important caveats regarding these conclusions must be mentioned. The political bias, if any, of the economics teacher may have affected the attitudes of the students who had completed the economics course. A second problem involves the long-term retention of the change in economic knowledge and attitudes toward economic issues on the part of the students who had taken the economics course. It is, therefore, recommended that additional study be done in this area and that a larger sample of students and teachers be involved. In addition the students should be re-tested one year later to determine if the initial difference in economic knowledge and attitudes toward economic issues between students who have and have not studied economics still exist.

APPENDIX

SOCIAL OPINION QUESTIONNAIRE

This is an opinion survey; there are no "right" or "wrong" answers. Please indicate how you feel or believe about each statement by marking after the number of the question the letter or letters that indicate your opinion. Do not take too much time over each statement.

OPINION	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Lettermark	SA	A	U	D	SD

____ 1. Private enterprise operating in a democratic political structure has been historically proven to be the most efficient economic governmental system. (.6)

____ 2. The nationalization of the great industries is likely to lead to inefficiency, bureaucracy and stagnation. (.35)

____ 3. It is up to the government to make sure that everyone has a secure job and a good standard of living. (-.65)

____ 4. Capitalism is immoral because it exploits the worker by failing to give him full value for his productive labor. (-.5)

____ 5. It is the responsibility of the entire society, through its government, to guarantee everyone adequate housing, income and leisure. (-.65).

____ 6. It is a fundamental American tradition that the individual must remain free of government interference, free to make money and spend it as he likes. (.5)

____ 7. Poverty could be almost entirely done away with if we made certain basic changes in our social and economic system. (-.5)

69

___ 8. The government should own and operate all public utilities (transportation, gas and electric, railroads, etc.). (-.6)

___ 9. Labor unions should become stronger and have more influence generally. (-.45)

___ 10. Ultimately, private property should be abolished and complete socialism introduced. (-.6)

___ 11. In general, full economic security is harmful; most men wouldn't work if they didn't need the money for eating and living. (.3)

___ 12. The expenses involved in college education are a private matter, and it is the duty of the family and student to meet these costs. (.45).

___ 13. People should plan for their old age and other possible situations of financial need rather than having the government do it for them. (.5)

___ 14. Most unemployed persons are simply too lazy to work. (.65)

___ 15. The tax system in the U.S. today is unfair to the poor. (-.55)

___ 16. Our most important industries ought to be owned and/or controlled by society as a whole, for the good of all the people, rather than by private business seeking profits. (-.6)

___ 17. The profit motive has been responsible for most of the evils in our economic system. (-.4)

LITERATURE CITED

Bach, G.L. and Saunders, Phillip. "Economic Education: Aspirations and Achievements," *Amer. Econ. Rev.*, June 1965, 55(2), pp. 329-56.

Campbell, Donald T. "Factors Relative to the Validity of Experiments in Social Settings," *Psy. Bull.*, June 1957, 54(2), pp. 297-312.

Dawson, George C. "Changing Student Attitudes," *Improv. Col. and Univ. Teach.*, Summer 1966 14(2), pp. 200-03.

_____. "Special Report: An Overview of Research in the Teaching of College Economics," *J. Econ. Educ.*, Spring 1976 7(2), pp. 111-16.

Lewis, D.R. and Orvis, C.C. *Research in Economic Education: A Review, Bibliography, and Abstracts*. NY: Joint Council on Economic Education, 1979.

Riddle, Terry. "Student Opinions and Economic Issues," *J. Econ. Educ.*, Spring 1978 9(2), pp. 111-14.

Scott, James H. Jr. and Rothman, Mitchell P. "The Effect of an Introductory Economics Course on Student Political Attitudes," *J. Econ. Educ.*, Spring 1975 8(2), pp. 107-12.

Soper, John C. "Needs for Evaluation in Economic Education," *Perspectives on Economic Education*. ED.: Nonald R. Wentworth et al. NY: Joint Council on Economic Education, 1977.

_____. *Test of Economic Literacy, Discussion Guide and Rationale*. NY: Joint Council on Economic Education, 1979.

Sosin, Kim and McConnell, Campbell R. "The Impact of Introductory Economics on Student Perceptions on Income Distribution," *J. Econ. Educ.*, Fall 1979 11(2), pp. 13-19.

Stigler, George. "The Politics of Political Economists," *Quart. J. Econ.*, Nov. 1959 73(4), pp. 522-32.

Tuckman, Howard P. "Teacher Effectiveness and Student Performance," *J. Econ. Educ.*, Fall 1975 7(1), pp. 34-39.

PLASMA CORTICOSTERONE LEVELS AND BEHAVIOR IN THE MALE
EASTERN WILD TURKEY (*MELEAGRIS GALLOPAVO SILVESTRIS*)[1],[2]

Ray N. Barber[3] and Michael E. Lisano
*Department of Zoology-Entomology and
Alabama Agricultural Experiment Station,
Auburn University, Alabama 36849*

Two hundred fifty-two plasma samples were taken from 16 captive, male eastern wild turkeys in 18 biweekly collections from mid-October 1975 to mid-June 1976. Plasma corticosterone concentrations were measured by a competitive protein binding procedure.

Each bird was classified by age and behavioral characteristics in response to specific visual stimuli resulting from the presence or absence of other male and/or female birds. Behavioral characteristics for each bird were based on daily observations and were correlated with plasma corticosterone values.

Visual stimuli appeared to play a role in determining plasma corticosterone levels during the breeding season. Male birds exposed to other males or females had higher plasma corticosterone values (3.20 µg/dl) than did male birds exposed to both males and females or neither (2.30 µg/dl). Plasma corticosterone levels of birds classified as aggressive-sexually motivated and nonaggressive-sexually unmotivated were not significantly different ($p > 0.05$) although an increase in levels of both groups occurred during the breeding season with values of about 3.0 µg/dl compared to average non-breeding levels of 2.25 µg/dl. The same general pattern and lack of significant statistical difference between groups were observed when birds were classified according to age.

INTRODUCTION

Aggression has been shown to play a major role in development of dominance heirarchies in the domestic fowl (Guhl, 1953) and in the wild turkey (Hewitt, 1967). Flickinger (1961) found that adrenal weights of sexually mature male chickens correlated reciprocally with social rank. His results indicated that sight or sound interactions between birds might be important in stimulating adrenal response. Brown (1960) showed that severe stressors such as cold, water deprivation, and starvation produce a significant increase in plasma corticosterone levels of the domestic turkey and Whatley et al. (1976)

showed that trapping stress increased plasma corticosterone levels in
the eastern wild turkey.

Similar studies in mice by Bronson and Eleftheriou (1964), and
Louch and Higginbotham (1967), showed that aggression and psychologi-
cal factors both played a role in stimulating adrenocortical re-
sponse.

Whether visual stimuli, in the absence of agonistic encounters,
can also produce an increase in plasma corticosterone levels in the
turkey has not been shown. Therefore, this study was designed to
determine if a relationship exists between visual stimuli which re-
sult in altered behavioral patterns and plasma corticosterone levels
which are indicators of stress.

METHODS

Birds

Sixteen male eastern wild turkeys ranging in age from 6 months
to 4 years were used. Eight young birds (less than 1 year) came from
a wild population on St. Simons Island, near Brunswick, Georgia.
Three older birds (more than 1 year) were hatched in a commercial
incubator from eggs found in an abandoned nest in Bullock County,
Alabama. The remaining five birds were acquired from Dr. James
Lindsay of the Cooperative Wildlife Research Unit at Pennsylvania
State University. The eggs from which these birds hatched came from
nests located in different areas of Pennsylvania. Each male was
marked with numbered leg bands and housed in an individual wood-wire
cage approximately one cubic meter in size and containing a perch.
In addition to the males, eight female eastern wild turkeys were
housed (2 per cage) in the same type of cages. All birds were kept
at the Auburn University Wildlife Research Facility located one-half
mile from the main campus in a secluded, wooded area. Food (Purina
game-bird Layena) and water were provided *ad libitum*. Overhead
canvas and natural vegetation provided protection from the elements.

Pen Arrangement

To experimentally test for a relationship between stress and
social interaction, exclusive of combat, four separate pen areas were
used. Cages were arranged in each area so as to expose each bird in
that area to nearly identical visual stimuli (Figure 1). In area 1,
male birds were exposed to females and also to other males. In area
2, male birds were exposed to females but not to other males. In
area 3, male birds were exposed to other males but not to females,
and area 4 contained only males with no visual contact with one
another. In all cases the possibility of audible interaction still
existed. A systematic pattern of daily observation was established
to correlate behavior and biochemical test.
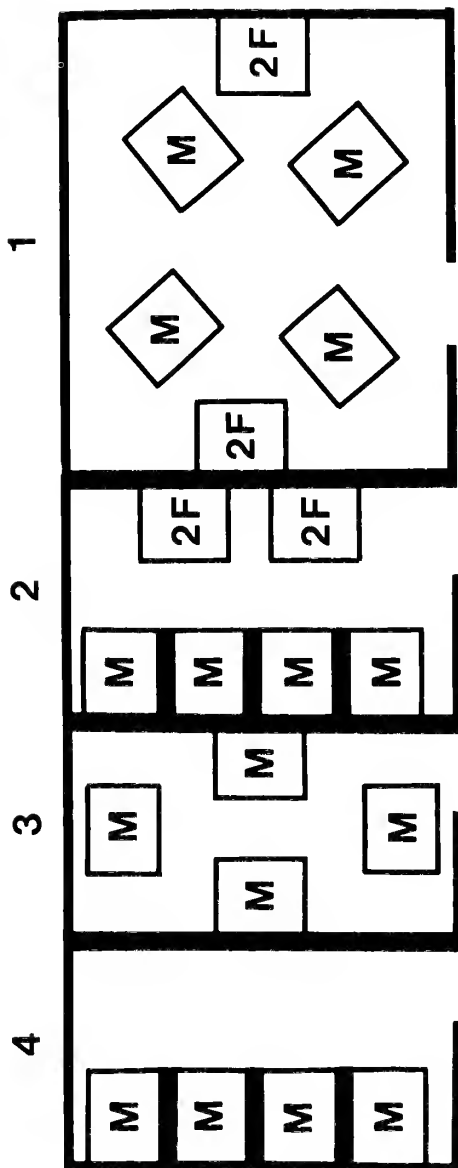
Figure 1. Pen Arrangements of Eastern Wild Turkeys at the Auburn University Wildlife Research Facility.

Visual Observation of Behavior

Each bird was observed daily, and aggressive and/or sexual displays were noted. The birds were then classified as to being aggressive-sexually motivated (A-SM) or nonaggressive-sexually unmotivated (NA-SU).

Aggressive behavior is characterized by threat displays and combative attempts which consist of leaping, pecking, and jumping at an individual. In the threat display, the bird assumes a sleek appearance by altering the position of the feathers. The head is thrust forward, and the wings are held away from the body. This is then followed by combative attempts (Hewitt, 1967).

Sexual behavior is characterized by a feather display and changes in the head ornamentation which occurs during the breeding season. The body feathers become ruffled, the tail feathers are fanned, and the primary coverts are pointed to the ground. The snood is elongated, and the caruncles are enlarged (Hewitt, 1967).

Blood Collection and Assay

Collection of blood samples began in mid-October, 1975, and continued for 8 months to mid-June 1976. Samples were collected every two weeks between 1000 and 1400 hours. The same bird sequence was used each week to avoid diurnal variation that might be present.

Each bird was weighed and then approximately 3 ml of blood was collected into a vacutainer containing an EDTA solution. The blood was immediately centrifuged for 10 minutes at 2000 X G and the plasma pipetted into clean vials, stoppered, labeled, and stored at $-10°$ C.

A competitive protein binding (CPB) procedure developed by Baum et al. (1974) utilized mammalian corticosteroid binding globulin with Se^{75} labeled cortisol and plasma cortisol competing for binding sites. Whatley, et al. (1976) found that plasma corticosterone concentrations could be measured using the same procedure if the cortisol standards were replaced by corticosterone standards. Cortipac CPB assay kits (Amersham/Searle) were used for the corticosterone determination.

Statistics

Data collected in this study were organized into 18 intervals, each containing three separate categories which included pen arrangement, behavioral traits, and age. A one-way analysis of variance (ANOVA) was used for each interval to test for correlations between pen arrangements and plasma corticosterone levels. All 18 intervals were combined and tested with ANOVA using regression to determine if differences occurred between the birds of different pen arrangements during the length of the study. ANOVA, with age and behavioral traits used as effects, was performed for each interval, and linear

and curvilinear regressions were used in AVOVA to test the time elements for trends in plasma corticosterone levels.

RESULTS AND DISCUSSION

The mean plasma corticosterone levels obtained for the male birds during the 18 biweekly collection periods are graphically displayed in Figure 2 according to pen areas. The mean plasma corticosterone in mid-October (collection 1) ranged from 3.68 ± 0.56 µg/dl to 5.80 ± 1.10 µg/dl. These values are higher than the average value (approximately 2.25 µg/dl) for the 18 collection periods. This initial high level might be due to the birds being unaccustomed to the handling and collection procedures. Duncan (1974) suggested that handling and surgical procedures may indeed be among the most stressful situations encountered by the bird. The mean corticosterone levels in birds of all pen areas decreased steadily through late October and early November and reached a stable level in mid-November with an average corticosterone value of 2.10 µg/dl. This is very close to the 2.13 µg/dl average plasma corticosterone value obtained by Whatley, et al. (1977). This decline and ultimate stability of mean corticosterone levels probably resulted from the birds habituating to the stress associated with sample collection. The values for all pen areas remained stable until early January, when an upward trend occurred. This elevation of the mean corticosterone values in all pen areas continued until late March. During this 3-month period, the breeding season, the mean corticosterone values of the four pen areas differed considerably. Birds in areas 2 and 3 had significantly higher (p<0.05) mean corticosterone values than the birds in areas 1 and 4. The mean for area 2 was the highest (3.36 ± 0.09 µg/dl) with area 3 being only slightly lower (3.30 ± 0.43 µg/dl). Average values for areas 1 and 4 were also very close. Area 1 had a mean value of 2.31 ± 0.22 µg/dl while area 4 had the lowest mean value of all the pen areas with 2.27 ± 0.34 µg/dl.

The visual presence of other birds seemed to play a major role in the observed pattern of mean corticosterone levels of birds in each pen area. Birds in area 2 were allowed visual contact only with female turkeys, while birds in area 3 could only see other males. Even though both areas had similar mean plasma corticosterone levels, the birds in each area might have attained these levels due to completely different physiological responses. Area 2 birds were able to see females, but sexually motivated behaviors other than displays were thwarted. The resulting appetitive displays and stress may have induced the observed corticosterone levels. On the other hand, area 3 birds could see only males, and the aggressive tendencies exhibited by these turkeys, if mediated in part through the visual sense, would probably still result in the rise in plasma corticosterone levels. The birds of pen areas 1 and 4 may have had lower mean plasma corticosterone levels due to the visual stimuli to which they responded. Area 1 birds were allowed visual contact with other male birds and also females, while birds in area 4 were individually isolated from all other birds. The birds in area 1 might have been expected to

76
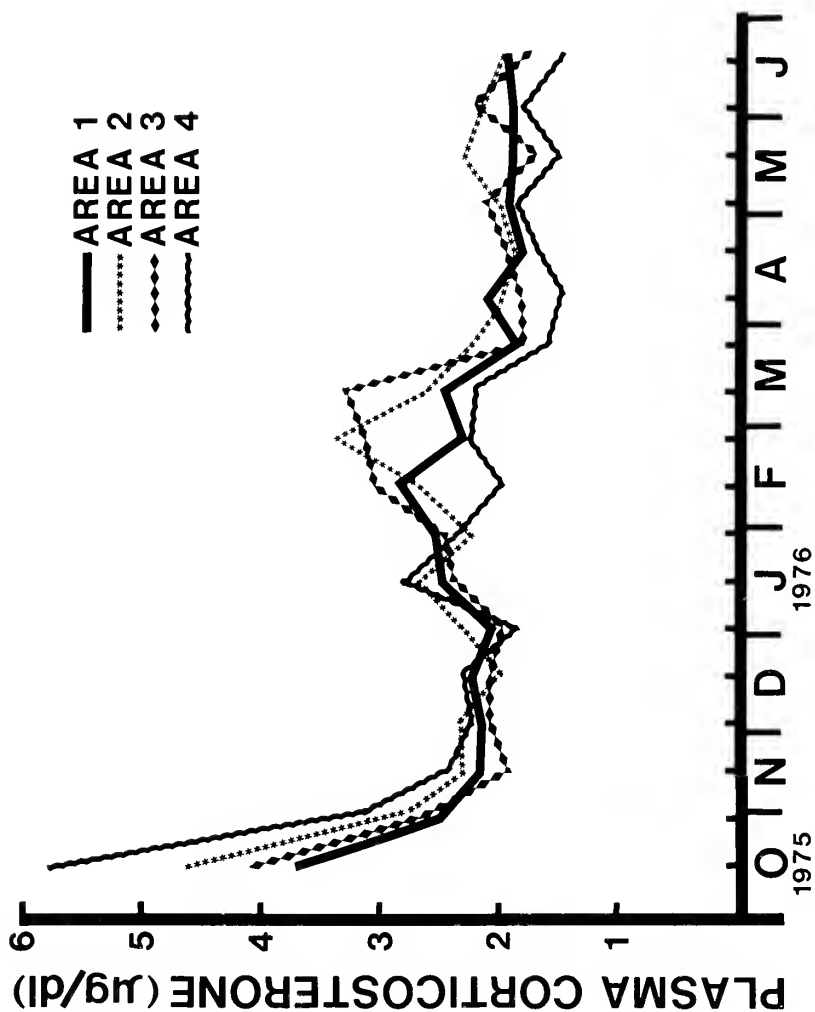
Figure 2. Mean Corticosterone Values for Male Eastern Wild Turkeys According to Pen Arrangement.

have the highest plasma corticosterone levels due to possible sexual and aggressive psychological stresses. However, exposure to visual stimuli from both females and other males may possibly have reduced, by unknown means, the effects of being able to see only one sex as was shown for areas 2 and 3. Consequently, plasma corticosterone levels did not rise significantly. In area 4, low plasma corticosterone values may have resulted from the birds having no visual contact with other birds and, therefore, not receiving stimuli which would initiate aggressive or sexual behavior.

Mean plasma corticosterone levels of birds in all pen areas (Figure 2) returned to approximately 2.00 µg/dl in late March and remained fairly stable through the last collection period in mid-June. This stable trend suggests that these birds are much more responsive to sexual and aggressive stimuli during the breeding season and less so out of the breeding season.

Based on results presented in Figure 2, the stimuli which evoke corticosterone secretion appear to be psychological in nature, and although demonstrated by different methods on different species, this hypothesis regarding the stimuli is essentially the same as that suggested by Louch and Higginbotham (1967) in their work on dominance in mice.

Based upon aggressive-sexually motivated behavioral classification traits, the mean plasma corticosterone levels obtained for the male birds during the 18 biweekly collection periods are displayed in Figure 3. During the initial collection in mid-October the means and standard errors of corticosterone values were 4.46 ± 0.60 µg/dl for birds classified as aggressive-sexually motivated (A-SM) and 4.67 ± 1.09 µg/dl for those judged to be non aggressive-sexually unmotivated (NA-SU). A sharp decline in corticosterone levels occurred in the remaining October and November collections, and by early December, the average corticosterone value of the birds was about 2.20 µg/dl. The initially high mean corticosterone levels and the successive tapering off which followed were probably due to handling and needle stress. As the birds became habituated to the collection procedures, the stress related corticosterone levels dropped off. In late December, the mean plasma corticosterone level of both groups began to increase, reaching a maximum of 2.94 ± 0.18 µg/dl in A-SM birds and 2.60 ± 0.38 µg/dl NA-SU birds by late February. During this increasing trend, which parallels the breeding season, the mean corticosterone level for A-SM birds was usually higher than the mean for NA-SU birds. However, these levels were not statistically different ($P>0.5$).

A decline in mean corticosterone levels for both the A-SM and NA-SU birds began in early March and leveled off in mid-March at about 1.82 µg/dl. From mid-March through the last collection in June, the levels remained relatively stable. The decline in corticosterone levels in early March probably resulted from a decrease in stress associated with aggressive and sexual behavior as the breeding
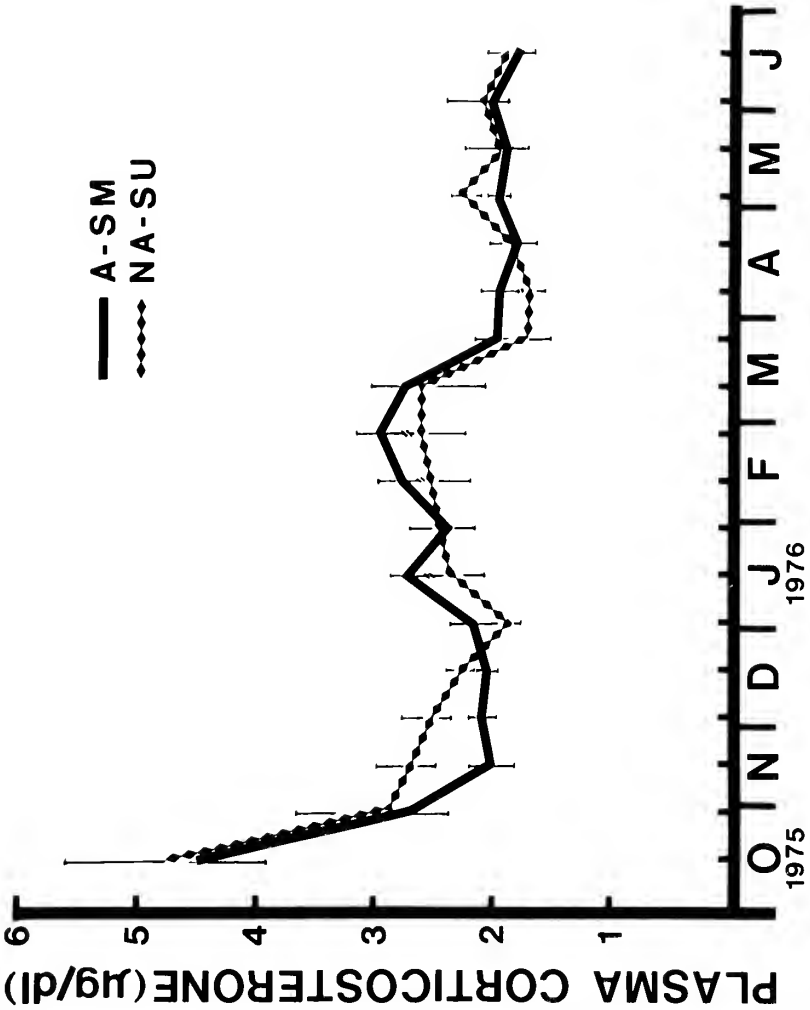
Figure 3. Mean Corticosterone Values (±S.E.M.) for Aggressive-Sexually Motivated (A-SM) and Nonaggressive-Sexually Unmotivated (NA-SU) Eastern Wild Turkeys.
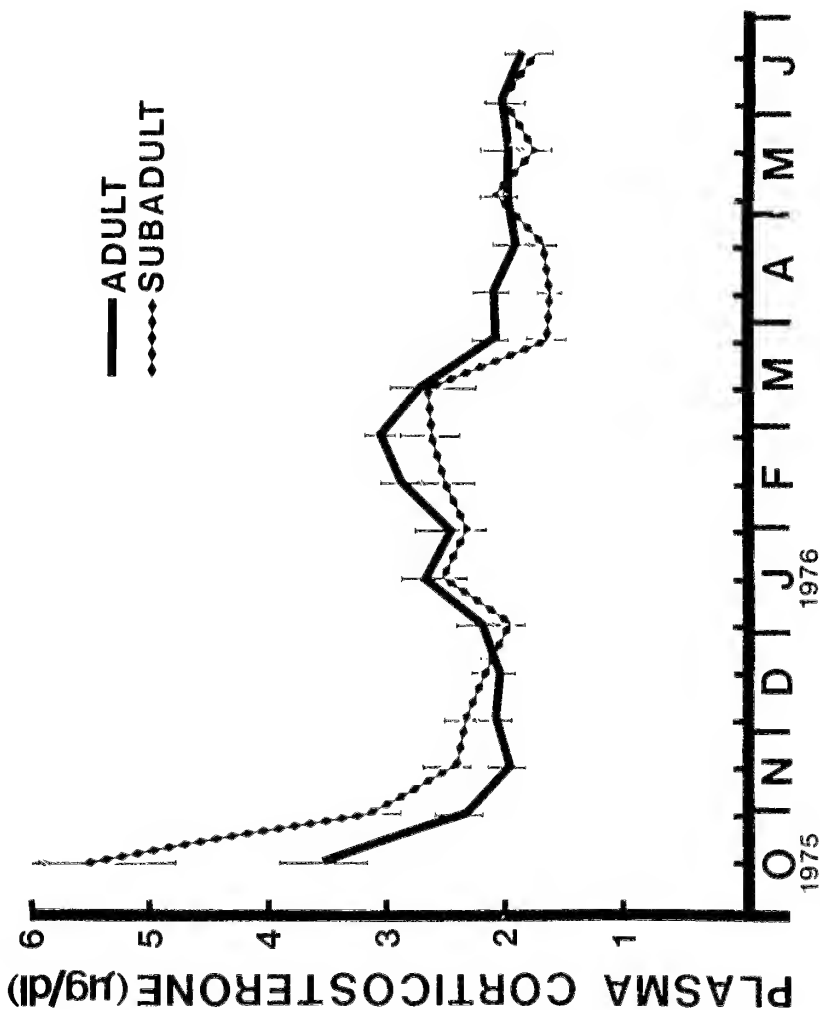
Figure 4. Mean Corticosterone Values (±S.E.M.) for Adult and Subadult Male Eastern Wild Turkeys.

period began to end. The stable levels which occurred the last $3\frac{1}{2}$ months are possibly due 'a continuation of this lower level of stress in the birds when out of the breeding season.

The mean plasma corticosterone levels obtained for the adult and subadult male birds, during the 18 biweekly collection periods, are graphically displayed in Figure 4. The ranking factor used to separate subadults from adults was 14 months of age (Hewitt, 1967). The mean plasma corticosterone levels for adult and subadult birds differed significantly ($p<0.05$) in collections 1 and 2 (both during October). The values obtained for these first two collections were 3.53 ± 0.38 µg/dl and 2.31 ± 0.20 µg/dl for adult birds and 5.51 ± 0.80 µg/dl and 3.20 ± 0.27 µg/dl for subadult birds. These values clearly show the elevated corticosterone levels of both adult and subadult birds in the initial collections. By mid-November (collection 3), the mean plasma corticosterone values for both groups had decreased considerably and leveled off around 2.20 µg/dl as the birds became habituated to the handling and needle stress. The mean values remained stable until early January, at which time a rising trend was observed. From January to mid-March, both adult and subadult birds had elevated mean plasma corticosterone levels, with the mean for adult birds reaching a peak value of 3.05 ± 0.15 µg/dl in late February and the mean for subadult birds reaching a peak value (2.65 ± 0.31 µg/dl) in early march. This overall pattern of both groups during this 10-week breeding period consistently showed adult birds having the higher mean corticosterone level; however, the means were not statistically different. This elevation of values during the breeding season may have resulted from the sexual and aggressive tendencies of these birds which were discussed previously. The reason for the adult values being consistently higher than the subadult values during this period is probably the same as that discussed for A-SM birds over NA-SU birds.

The mean corticosterone values for both groups began to decrease in mid-March as the breeding season came to an end and stabilized at approximately 2.00 µg/dl for the remainder of the study. The overall pattern is very similar to that of mean plasma corticosterone values when birds were grouped according to behavioral traits.

REFERENCES

Baum, C.K., Tudor, R., and Landon, Jr. (1974). A simple competitive protein binding assay for plasma cortisol. Clin. Chem. Acta. 55, 147-154.

Bronson, F.H., and Eleftheriou, B.E. (1964). Chronic physiological effects of fighting in mice. Gen. Comp. Endocrinol. 4, 9-14.

Brown, K. I. (1960). Response of turkey adrenals to ACTH and stress as measured by plasma corticosterone. Anat. Record 137, 344.

Duncan, I.J.H. (1974). The behavior of the domestic fowl in stressful situations. Brit. Vet. J. 130, 89-90.

Flickinger, G.L. (1961). Effect of grouping on adrenals and gonads of chickens. Gen. Comp. Endocrinol. 1, 332-340.

Guhl, A.M. (1953). Social behavior of the domestic fowl. Kansas Agr. Ept. Sta. Tech. Bull. 73, 1-48.

Hewitt, O. H., Ed. (1967). The wild turkey and its management. The Wildlife Society, Washington, D.C.

Louch, C.D., and Higginbotham, M. (1967). The relation between social rank and plasma corticosterone levels in mice. Gen. Comp. Endocrinol. 8, 441-444.

Whatley, H.E., Lisano, M.E., and Kennamer, J.E. (1977). Plasma corticosterone levels as an indicator of stress in the eastern wild turkey, *Meleagris gallopavo silvestris*. J. Wildlife Manage. 41(2):189-193.

PLASMA TESTOSTERONE LEVELS AND BEHAVIOR IN THE MALE
EASTERN WILD TURKEY (*MELEAGRIS GALLOPAVO SILVESTRIS*)[1],[2]

Harry B. Hines[3] and Michael E. Lisano
Department of Zoology-Entomology and
Alabama Agricultural Experiment Station,
Auburn University, Alabama   36849

This study was undertaken to establish a relationship between aggressive and sexual behavior and plasma testosterone concentrations in male eastern wild turkeys. Two variables were introduced to determine their effects upon these two behavioral traits and testosterone levels: differential male to male visual contact, and the absence or presence of females.

Sixteen male eastern wild turkeys were sampled biweekly for 36 weeks and the plasma samples were analyzed for testosterone by a radioimmunoassay procedure. Behavioral changes were noted daily throughout the collection period and compared to testosterone levels.

Variations in plasma testosterone concentrations were found for the nine month collection period in accordance with the recognized breeding season which is dependent upon photoperiod. Pen arrangements were found to influence testosterone levels. Males allowed unrestricted vision of each other and the females generally had higher mean plasma testosterone values than those viewing only females; while both males with visual contact restricted to other males, and males with no visual contact with other birds had the lowest values. Birds demonstrating aggressive and sexual displays, regardless of age, generally had higher plasma testosterone levels than those birds which did not.

INTRODUCTION

Behavior in animals is a complex phenomenon which is governed by both internal and external parameters. Physiologically, behavior has been shown to be affected by changes in the baseline secretion rates of various hormones (Balthazart and Stevens, 1975; Selinger and Beimont, 1967; Graber and Nalbandov, 1965). Psychologically, previous experiences, learning, and visual and auditory stimuli contribute to the behavioral patterns of the individual (Rowell, 1974; De Ghett, 1975). These physiological and psychological factors together comprise the behavioral activities of an individual. In addition, psychological experiences are closely interrelated with physiological responses (Flickenger, 1961). This study attempts to examine the

possibility that testosterone levels in male eastern wild turkeys may be affected by certain visual stimuli.

Domestic fowl and wild turkey populations exhibit a type of social system known as a peck-right peck order in which aggression is recognized as the major determinant of status in the dominance hierarchy (Hewitt, 1967). In the absence of physical contact, it is currently unknown if the more ostensible and/or precocious birds develop higher levels of testosterone than the nonaggressive, sexually inactive birds. The parameters for such assumed roles are unknown. In this study, there are two such parameters: visual and auditory. The visual aspect may be further defined to include unrestricted vision of other males and females, females only, males only, and completely restricted vision. No attempt was made to restrict auditory stimuli. It has been shown that a correlation exists between androgens and behavior in birds (Allee et al., 1939). Populations of birds which have a peck order have shown this interrelationship (Andrew, 1972; Selinger and Beimont, 1967). Also, work done with Rhesus monkeys has demonstrated a correlation between testosterone concentration and status in the social hierarchy when combat between individuals was allowed for social stratification (Rose and Holaday, 1971; Rose *et al.*, 1972). Androgen levels in avian species have also been shown to rise in response to increased lengths of light, and this rise results in increased aggression by the males (Graber and Nalbandov, 1965).

METHODS

Birds

Sixteen male eastern wild turkeys ranging in age from six months to four years were used in this study. Three of the birds, two years old, were hatched in a commerical incubator from eggs collected from a nest in Bullock County, Alabama. Five birds, greater than three years of age, were obtained from Dr. James Lindsey of the Wildlife Research Unit at Pennsylvania State University and were from different areas of the state. The remaining eight birds were less than one year old, and were obtained from a wild population on St. Simon's Island, Georgia. All birds were leg-banded for identification. Each male was individually housed in a cage constructed of wood and wire, approximately one cubic meter in size. Females used in the experiment were housed two to a cage. The top of each cage was covered with canvas to help prevent overexposure to climatic extremes. The interior of each cage contained one perch, one automatic feeder, and an automatic water dispenser. Purina Game Bird Layena and water were provided *ad libitum*. The cages were kept at the Auburn University Wildlife Research Facility, an area located in a wooded region approximately one-half mile from Auburn's main campus, yet secluded from any man-made stress situations.

Pen Arrangement

The cages were arranged to enhance or prohibit views of other males, females, or both. Canvas was used to visually seclude individuals where necessary and to prevent their viewing one pen from another (Figure 1). In Area 1, males were allowed unrestricted vision of each other and the females. In Area 2 the males could easily see the females but not each other. In Area 3, no females were present, but males could view each other, and in Area 4, no visual contact between males was permitted, and no females were present.

Visual Estimation of Behavior

Daily visual observations and notations were made concerning the activity of each bird. These observations were evaluated for aggressive and sexual behavior.

Aggressive behavior is characterized by threat displays and combative attempts which consist of leaping, pecking, and jumping at an individual. In the threat display, the bird assumes a sleek appearance by altering the position of the feathers. The head is thrust forward, and the wings are held away from the body. This is then followed by combative attempts (Hewitt, 1967).

Sexual behavior was considered because it is closely correlated with social rank. Sexual behavior is characterized by a feather display and changes in the head ornamentation which occurs during the breeding season. The body feathers become ruffled, the tail feathers are fanned, and the primary coverts are pointed to the ground. The snood is elongated, and the caruncles are enlarged (Hewitt, 1967). If an individual exhibited these displays, it was considered to be aggressive-sexually motivated (A-SM). If these activities were not seen for an individual, it was classified as being nonaggressive-sexually unmotivated (NA-SU).

Blood Collection and Assay

Collection of blood samples began in mid-October, 1975, and continued for eight months to mid-June 1976. Samples were collected every two weeks between 1000 and 1400 hours. Each bird was weighed and then approximately 3 ml of blood was collected into a vacutainer (Becton-Dickinson) containing an anticoagulant, EDTA, as a 15% solution. The blood was immediately centrifuged for 10 minutes at 2000 X G and the plasma pipetted into clean vials, stoppered, labeled, and stored at $-10°$ C. Plasma testosterone concentrations were determined on duplicate 100 microliter samples using a radioimmunoassay (RIA) kit (Wien Laboratories). The kit included buffer, dextran-coated charcoal, antibody, H^3-testosterone and control sera. Dichloromethane was used as the solvent for extraction purposes. Before using, dichloromethane and methanol, which was used to cleanse all glassware, were glass-distilled. Water used in the
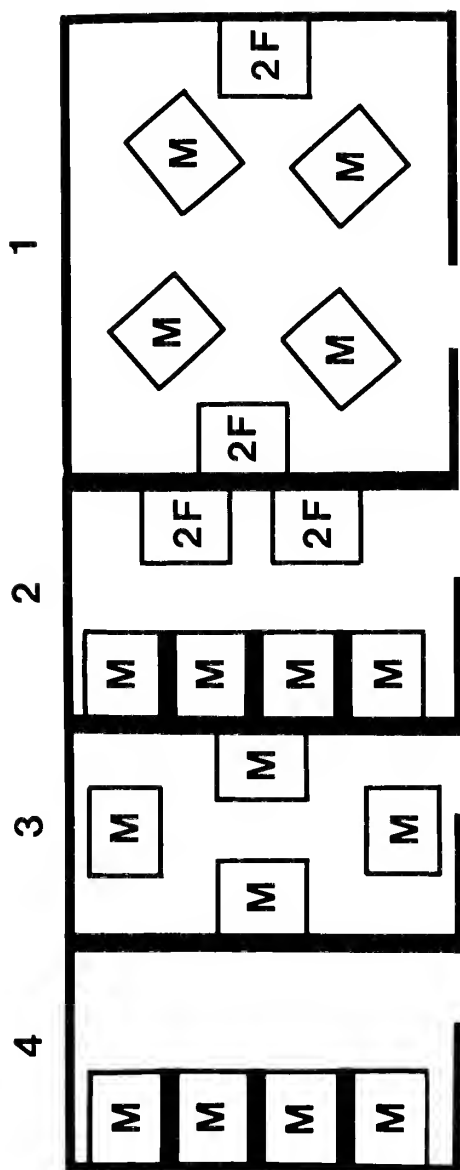
Figure 1. Pen Arrangement for Each Study Area at the Auburn University Wildlife Research Facility, for Eastern Wild Turkeys.

procedure was purified by ion-exchange deionization and then glass-distilled. All procedures recommended for this kit were followed. An lsocap 300 liquid scintillation counter (Searle, Inc.), set for tritium determination, was used to measure readioactivity. Plasma testosterone concentration (ng/dl) for each sample was calculated by comparison to a standard curve.

Statistical Analyses

Using a least squares analysis of variance, plasma testosterone data were analyzed with respect to pen arrangement, intervals (collection times), age, behavioral classification, arrangement x interval, and arrangement x age x behavioral classification per interval. In addition, the means and standard errors of the mean (S.E.M.) for each collection for the categories of adult vs. subadult, test area, and aggressive-sexually motivated (A-SM) vs. nonaggressive-sexually unmotivated (NA-SU) were calculated.

RESULTS AND DISCUSSION

A total of 252 plasma samples were obtained by biweekly sampling of 16 eastern wild turkeys for eight months.

Figure 2 shows the average plasma testosterone values for the birds in each study area per collection. As can be seen a definite relationship exists between a rise in mean plasma testosterone levels and the breeding season (March to May). From October to January, the mean testosterone values ranged from 27 ± .83 ng/dl to 86.2 ± 11.5 ng/dl. However, in mid-January, the mean plasma testosterone level (100.0 ± 15.5 ng/dl) for the birds of Area 1 showed a large deviation from the other values. In late January, mean plasma testosterone level (149.0 ± 35.7 ng/dl) for the birds of Area 2 also demonstrated a dramatic increase. For the breeding season, the overall trend of the birds of Areas 1 and 2 was higher than those of Areas 3 and 4. Generally, 1 was higher than 2 which was higher than 3 which was followed by 4. The increases in January for Area 1 and 2 birds are interesting because they occurred five to six weeks before the beginning of the breeding season, and at least three to four weeks before the breast sponge begins to develop on the male.

By late January, the mean plasma testosterone values for Area 3 birds began to show a discernible increase. Area 4 birds showed no such increase but oscillated regularly throughout the breeding season. The mean plasma testosterone levels for the birds of Areas 1, 2, and 3 increased as the breeding season approached, peaked during the breeding season, and returned to near pre-breeding season levels by mid-May. It should also be noted that as conspecific visual stimuli (vision of other males and/or the presence of females) were increasingly restricted for the various areas, the average testosterone values decreased. That is, Area 1, in which males were permitted to view both other males and females, had the highest mean plasma testosterone values for the breeding season, and Area 4, in which no females were present and no vision of the other males was
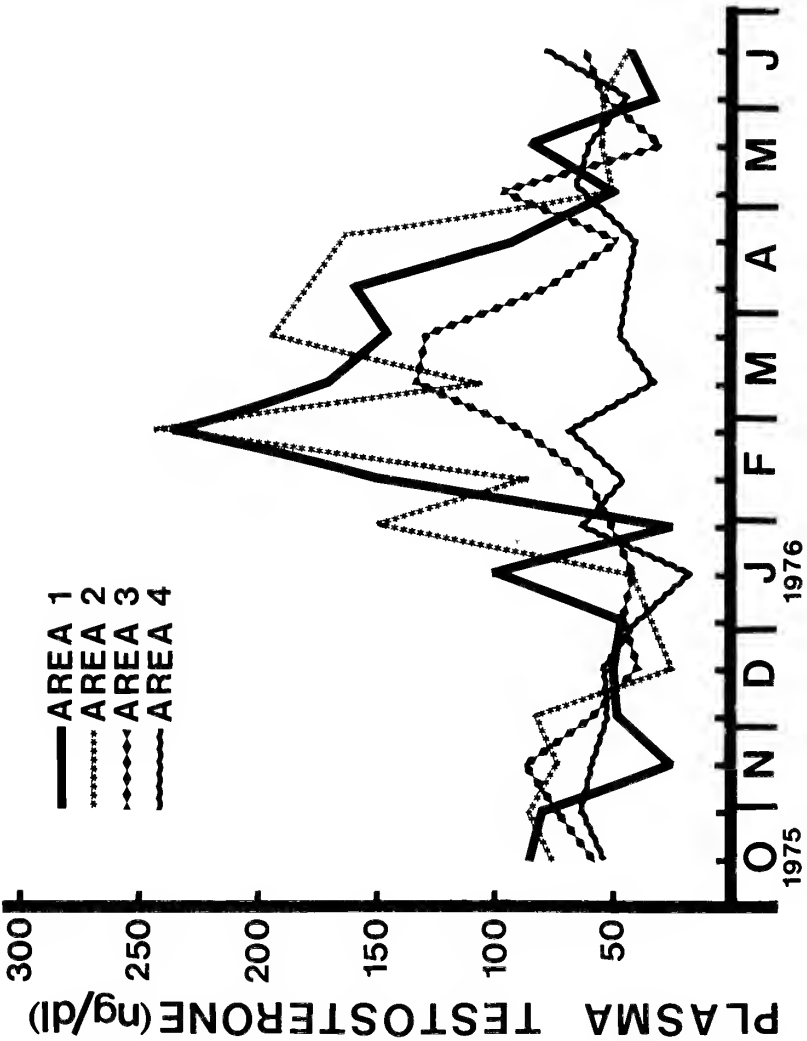
Figure 2.   Mean Plasma Testosterone Levels for Male Eastern Wild Turkeys According to Pen Arrangement.

permitted, had the lowest mean testosterone values for the breeding season. However, statistical analysis for arrangements for each collection (interval) showed no significant differences (p>.05).

These values obtained at different periods of the annual cycle are consistent with the annual variation obtained for the duck (Balthazart and Hendrick, 1976), red-winged blackbird (Kerland and Jaffe, 1974), pigeon (Rivarola *et al.*, 1968), and the eastern wild turkey (Lisano and Kennamer, 1977). Therefore, it may be assumed that a testicular cycle exists for the eastern wild turkey as it does for other birds such as the Japanese quail (Follett and Farner, 1966). Also, it appears that the visual presence of females may contribute to testicular development as mean testosterone levels for birds in those areas containing females increased rapidly. It also appears that visual stimuli are important since low mean testosterone values for Area 4 occurred throughout the year. However, statistical analysis of arrangements with each collection (interval) showed no significant differences (p>.05) with the exception of the mid-November collection (p<.05).

The values obtained for the various areas at different periods of the annual cycle correspond to those obtained for other birds, especially the pigeon. Rivarola *et al.* (1968) found that plasma testosterone values for the breeding season of the pigeon ranged between 15 and 98 ng/dl. The results of Lisano and Kennamer (1977) also showed a close parallel to those obtained here. Balthazart and Hendrick (1976) reported that in the duck, plasma testosterone levels were 640 ± 10 ng/dl during the breeding season and 37 ± .28 ng/dl the nonbreeding season. The values obtained in our study were not as high for the breeding season, but nonseasonal values closely approximated the results of Balthazart and Hendrick (1976).

The mean plasma testosterone concentrations of adult and subadult birds are graphically illustrated in Figure 3. Both groups showed steadily decreasing mean values from October to January. During this period, both groups averaged between 45 and 50 ng/dl. In early January, the mean values for the adults began a rise which continued until a peak (202.6 ± 46.6 ng/dl) was reached in late March, after which the values steadily declined until they returned to pre-breeding levels in May. In mid-January, the mean levels for subadults began to increase as the breeding season approached and peaked in late February (115.0 ± 49.6 ng/dl). After this initial increase, the levels remained relatively constant, varying almost sinusoidally, until the end of the collection period. Significant differences (p<.05) were found when ages were compared with plasma testosterone levels for the entire collection period using an analysis of variance test for unequal samples. The differences were found for collections 1, 7, 11, and 14.

Plasma testosterone levels of birds considered to be A-SM or NA-SU are presented in Figure 4. These results parallel those of Figure 3 (adults vs. subadults). Generally, it may be stated that adults exhibited A-SM behaviors, but not in every case. The mean levels of
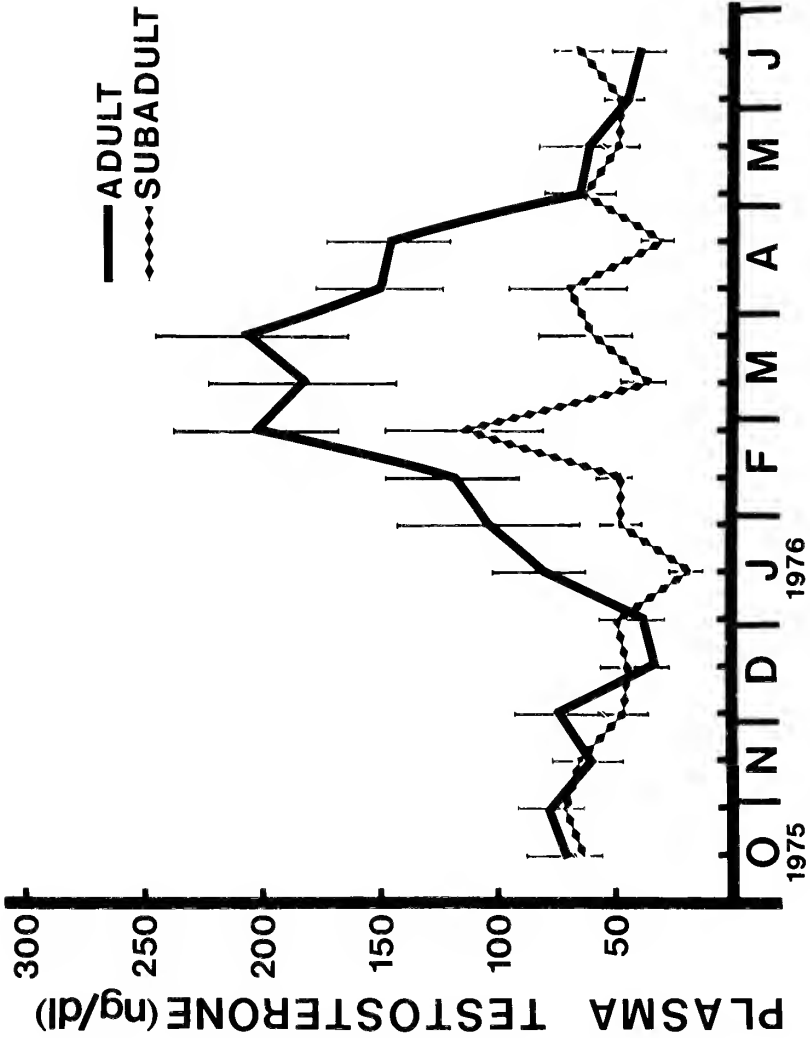
Figure 3. Mean Plasma Testosterone Levels ($\pm$ S.E.M.) for Adult and Subadult Male Eastern Wild Turkeys for Nine Months.
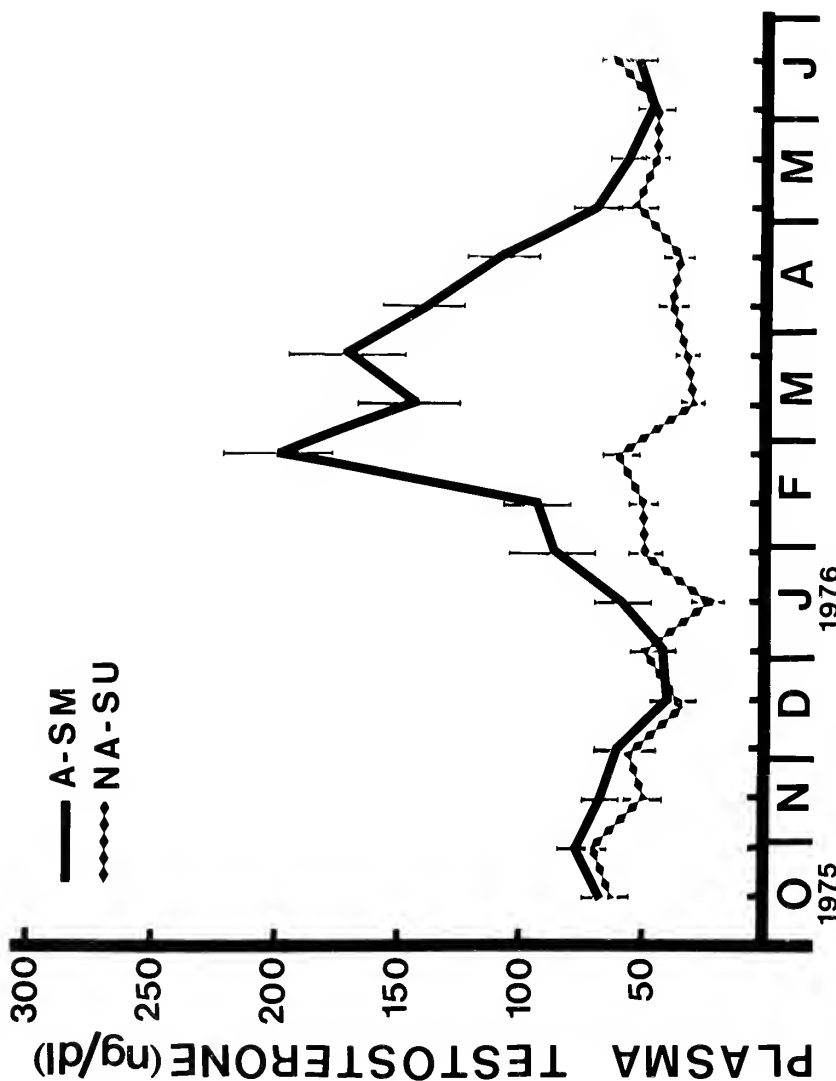
Figure 4. Mean Plasma Testosterone Levels (+ S.E.M.) for Aggressive-Sexually Motivated (A-SM) and Nonaggressive-Sexually Unmotivated (NA-SU) Male Eastern Wild Turkeys Over a Nine Month Period.

testosterone for both groups are very close for the pre-breeding and post-breeding seasons. For the A-SM birds, mean testosterone levels began to rise in January and peaked during the February-March period (199 ± 42.6 ng/dl) after which the values decreased. Mean values for NA-SU birds showed an increase from January through February followed by a decrease and constancy for the rest of the collection period. Statistically, there was a significant difference (p<.05) in testosterone levels for A-SM birds over NA-SU birds from mid-January through the later part of April.

For a bird to be considered A-SM, it had ∴ si w increased aggressive and sexual displays. As plasma testosterone levels increased apparently in response to increases in photoperiod, so did aggression and sexual behavior. This suggests testosterone may have influenced these actions as has been shown in the domestic turkey (Lake and Furr, 1971). This also correlated with experimentation that indicates testosterone leads to increased aggression in chickens (Allee *et al.*, 1939; Andrew, 1972), Japanese quail (Selinger and Beimont, 1967), and mammals (Erpino and Chappelle, 1971; Davis and Gandelman, 1972; and Lincoln *et al.*, 1972).

It may be of interest to note that all biı receiving the A-SM designation were not adults. This suggests tha. age alone is not totally responsible for aggressive behavior which may also involve ramifications of psychological stimuli.

REFERENCES

Allee, W. C., Collias, N. E., and Lutherman, C. Z. (1939). Modification of the social order in flocks of hens by the injection of testosterone propionate. Physiol. Zoo. 12:412.

Andrew, R. J. (1972). Changes in search behavior in male and female chicks following different doses of testosterone. Anim. Behav. 20:741.

Balthazart, J. and Stevens, M. (1975). Effects of testosterone propionate on the social behavior of groups of male domestic ducklings, *Anas platyrhynchos*. Anim. Behav. 23:926.

Balthazart, J. and Hendrick, J. (1976). Annual variation in reproductive behavior, testosterone, and plasma FSH levels in the Rouen duck, *Anas platyrhynchos*. Gen. Comp. Endocrinol. 28:171.

Davis, P. G. and Gandelman, R. (1972). Pup-killing produced by the administration of testosterone propionate to adult female mice. Horm. Behav. 3:169.

De Ghett, V. J. (1975). A factor influencing aggression in adult mice: Witnessing aggression when young. Behav. Biol. 13:291.

Erpino, M. J. and Chappelle, T. C. (1971). Interactions between androgens and progesterone in mediation of aggression in mice. Horm. Behav. 2:265.

Flickinger, G. L. (1961). Effect of grouping on adrenal and gonads of chickens. Gen. Comp. Endocrinol. 1:332.

Follett, B. K. and Farner, D. S. (1966). The effect of daily photoperiod on gonadal growth, neurohypophysial hormone content, and neurosecretion in the hypothalamohypophyseal system of the Japanese quail (*Coturnix coturnix japonica*). Gen. Comp. Endocrinol. 7:111.

Graber, J. W. and Nalbandov, A. V. (1965). Neurosecretion in the white leghorn cockerel. Gen. Comp. Endocrinol. 5:485.

Hewitt, O. H. (1967). The wild turkey and its management. The Wildlife Society, Washington.

Kerlan, J. T. and Jaffe, R. B. (1974). Plasma testosterone levels during the testicular cycle of the red-winged blackbird (*Agelaius phoeniceus*). Gen. Comp. Endocrinol. 22:428.

Lincoln, G. A., Guinness, F., and Short, R. V. (1972). The way in which testosterone controls the social and sexual behavior of the Red Deer Stag (*Cervus elaphus*). Horm. Behav. 3:375.

Lisano, M. E. and Kennamer, J. E. (1977). Seasonal variations in plasma testosterone levels in male eastern wild turkeys. J. Wildl. Manage. 41(2):184-188.

Rivarola, M. A., Snipes, C. A., and Migeon, C. J. (1968). Concentration of androgens in systemic plasma of rats, guinea pigs, salamanders, and pigeons. Endocrinology. 82:115.

Rose, R. M., Gordon, T. P., and Berstein, I. S. (1972). Plasma testosterone levels in the male Rhesus monkey: Influences of sexual and social stimuli. Science. 178:643.

Rowell, T. E. (1974). The concept of social dominance. Behav. Biol. 11:131.

Selinger, H. E. and Beimont, G. (1967). Hormonal control of aggressive behavior in Japanese quail (*Coturnix coturnix japonica*). Behavior. 28:255.

EFFECT OF LABEL LEVEL ON THE BIOELIMINATION
OF ^{65}ZN IN *POPILIUS DISJUNCTUS*[1],[2]

William H Mason, Lawrence C. Wit, and Dorothy E. Sherrill[3]
Department of Zoology-Entomology
Auburn University, Alabama 36849

ABSTRACT

Three groups of horned passalus beetles, *Popilius disjunctus* (Illiger),were labeled with either a low, intermediate, or high level of ^{65}Zn. Whole body assays of ^{65}Zn were made for 23 days post labeling. Individuals with low levels of ^{65}Zn excreted the label at a significantly slower rate that either those with intermediate or high levels. This finding identifies a possible major source of controllable variation in zinc excretion patterns in this experimental animal. Controlling this variation could strengthen the relationship between ^{65}Zn elimination and certain metabolic events, rendering the use of ^{65}Zn turnover rate a more dependable tool for the circuitous measurement of metabolic rate.

INTRODUCTION

The reliable estimation of metabolic rate in small, free-ranging animals is difficult. Indirect methods that have been developed include telemetered heart rate (Gessamen 1980), $D_2{}^{18}O$ turnover (Nagy 1980), and heavy metal depletion (Odum 1961, Odum and Golley 1963). The correlation of heavy metal turnover with metabolism has involved mainly radionuclides of zinc and iron.

Burnett et al. (1969), Rhodes and Mason (1971), Lauhachinda and Mason (1979), and Grant et al. (1980) reported significant positive relationships between ^{65}Zn elimination and oxygen consumption in several arthropods. Crossley (1966), Reichle and Dobson (1966), Reichle (1968), and Taylor (1978) reported relationships between radionuclide elimination and metabolism in a variety of invertebrates. Mason and McGraw (1973), Mason and Chiu (1976), Mason et al. (1976), and Brugh and Mason (1976) also reported significant positive correlations between the turnover of heavy metal radionuclides and egg production in several insect species. Gautney et al. (1981) described ^{59}Fe as giving the highest correlation between nuclide elimination and egg production in *Drosophila*, and reported that a

---

[3]Present address: John C. Calhoun State Community College, P. O. Box 2216, Decatur, AL 35602

mark-recapture experiment was feasible with these small, active animals.

One problem with using radionuclide turnover to calculate metabolic rate involves an apparent lack of uniformity in the rate of excretion of the nuclide once individual animals have ingested it. Mason et al. (1983) have recently shown that dietary pretreatment with unlabeled zinc markedly affects subsequent bioelimination of ^{65}Zn in *Popilius disjunctus*. Wit et al. (1983) also reported similar differences in ^{65}Zn bioelimination as a result of crowded versus uncrowded conditions. These findings make it imperative that all commonly confronted laboratory conditions be carefully evaluated in terms of their potential effect on radionuclide turnover. This study was undertaken to determine if the magnitude of the individual ^{65}Zn label affects the actual post-labeling rate of zinc excretion in *P. disjunctus*.

MATERIALS AND METHODS

Approximately 150 *P. disjunctus* were collected from decaying hardwood logs in Macon County, Alabama during late September. They were acclimated for several days in large plastic containers supplied with moist wood. Approximately 30 juveniles (as evidenced by their bronze color) were subsequently removed, and the remaining adults divided into eight groups of 15 beetles each. Each group was placed in a 10-inch glass stacking dish containing about 25 cm^3 of decaying wood soaked with 500 µg ZnCl$_2$. This unlabeled zinc pretreatment has been shown to reduce significantly the experimental variation in both labeling and excretion rates of animals subsquently labeled with ^{65}Zn (Mason et al. 1983). Since temperature affects ^{65}Zn excretion rate, these dishes were placed in total darkness for 12 days within a constant temperature chamber adjusted to 23 C, and left undisturbed (except to add water).

Approximately 8 cm^3 of decaying wood was placed in each of six 10-inch dishes. Two of the dishes were designated as low-label, two as intermediate-level, and two as high-level. Each batch of wood received a topical application of either 7 µCi ^{65}ZnCl$_2$, 22 µCi ^{65}ZnCl$_2$, or 92 µCi ^{65}ZnCl$_2$.

The 120 beetles were weighed and divided into one of three equal-sized groups of 40 animals each. One group of 40 beetles was designated as low-label, one as intermediate-label, and the other as high-label. Each of these three groups were split into two subgroups of 20 beetles each and placed in the appropriate labeling dish. The dishes were placed in the constant temperature chamber for 48 hours.

All three label groups were subsequently removed from the 10-inch labeling dishes and held in a ^{65}Zn-free environment for 48 hours. During this period much of the unabsorbed ^{65}Zn is voided from the gut. Individuals were then assayed for whole body ^{65}Zn burden by placing them posterior down in a plastic tube and lowering it into the well of a sodium iodide crystal scintillation detector scaler

system. A single channel analyzer was employed and adjusted to pass
only the ^{65}Zn photopeak.   Stability was maintained by use of a
Harshaw NA22 automatic gain control amplifier and occasional cali-
brations.   Individuals were assayed for one minute, and all counts
were corrected for background and physical decay of the nuclide.

On the basis of the initial ^{65}Zn burdens, each of the three
40-member groups was reduced to 30 members. This was accomplished by
eliminating those individuals from each group with extremely low or
high labels. As a result, the low-label group contained individuals
ranging from 12,107 to 29,818 CPM ($\bar{X}$ = 23,219), the intermediate-
group 40,422 to 89,374 CPM ($\bar{X}$ = 64,108), and the high-group 145,643
to 257,272 CPM ($\bar{X}$ = 199,421).

After labeling, beetles were transferred individually to 4-inch
stacking dishes floored with ¼-inch mesh hardware screen positioned
about 1 cm above the bottom of the dish. The screen allowed feces to
drop through, precluding the reingestion and consequent distortion of
the ^{65}Zn elimination data (Mason and Odum 1969, Schreiber and Mason
1976). Moist decaying wood was provided *ad libitum*. All dishes were
kept in total darkness within the constant temperature chamber.
Animals were removed from the chamber only for adding food and water
or for whole body ^{65}Zn measurements. Subsequent measurements of
whole body radiation were made on days 2, 4, 6, 12, 16, and 23 post
labeling.

RESULTS AND DISCUSSION

In Figure 1 the $\log_{10}$ mean percentage of radioactivity remain-
ing for the three experimental groups is plotted as a function of
time. The normalization of radionuclide data by using percentages is
common since individual beetles vary a great deal in respect to the
absolute amount of ^{65}Zn that they ingest (Mason and Odum 1969,
Schreiber and Mason 1976). The data in Figure 1 reveal that the
low-labeled individuals appear to eliminate the tracer at a slower
rate than do beetles of the other groups.

However, in analyzing curves such as those illustrated in Figure
1, it is not clear whether the apparent differences are due to dif-
ferences in the rapid initial loss of the nuclide (day 0-12), to
differences in the rate of the more gradual depletion (day 12-23), or
to differences in both the rapid and the gradual phases. Further-
more, previous studies (Grant et al. 1980, Wit et al. 1983), have
shown that the linear portion (day 12-23) best represents the ^{65}Zn
bound to the tissues, while the non-linear earlier portion of the
curves predominantly represents an unassimilated pool of the nuclide.
Therefore, the linear (latter) portion of these curves would seem to
be best suited for use in the circuitous evaluation of metabolism.
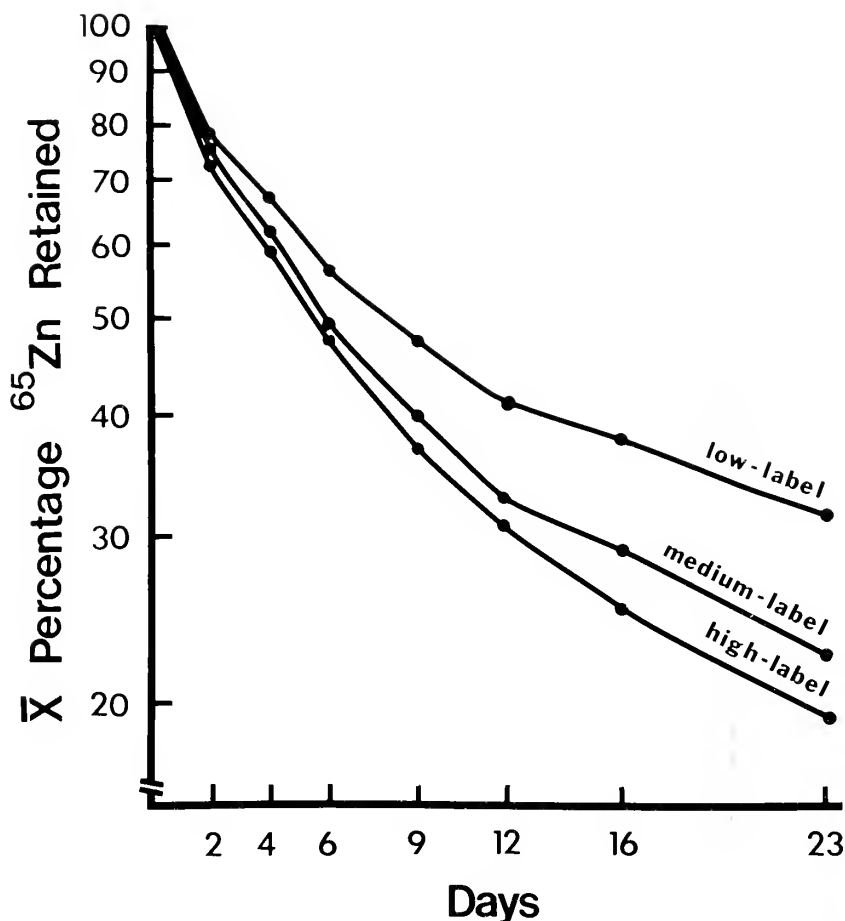
Figure 1.   Effect of Label Level on the Bioelimination of ^{65}Zn in
            Popilius disjunctus.

        Figure 2 represents the bioelimination of ^{65}Zn within the three
groups during the latter portion (day 12-23) of the experiment where
the $\log_{10}$ mean percentage of radioactivity remaining is plotted as
a function of time.   Values for day 12 are normalized to 100% since
it is assumed that these values represent 100% of the metabolic pool
(Wit et al. 1983).   Again, it appears that the low-labeled individu-
als excreted the nuclide at a slower rate than did the other groups.
In order to investigate this possibility statistically, the data were
subjected to an analysis of co-variance comparing the heterogeneity
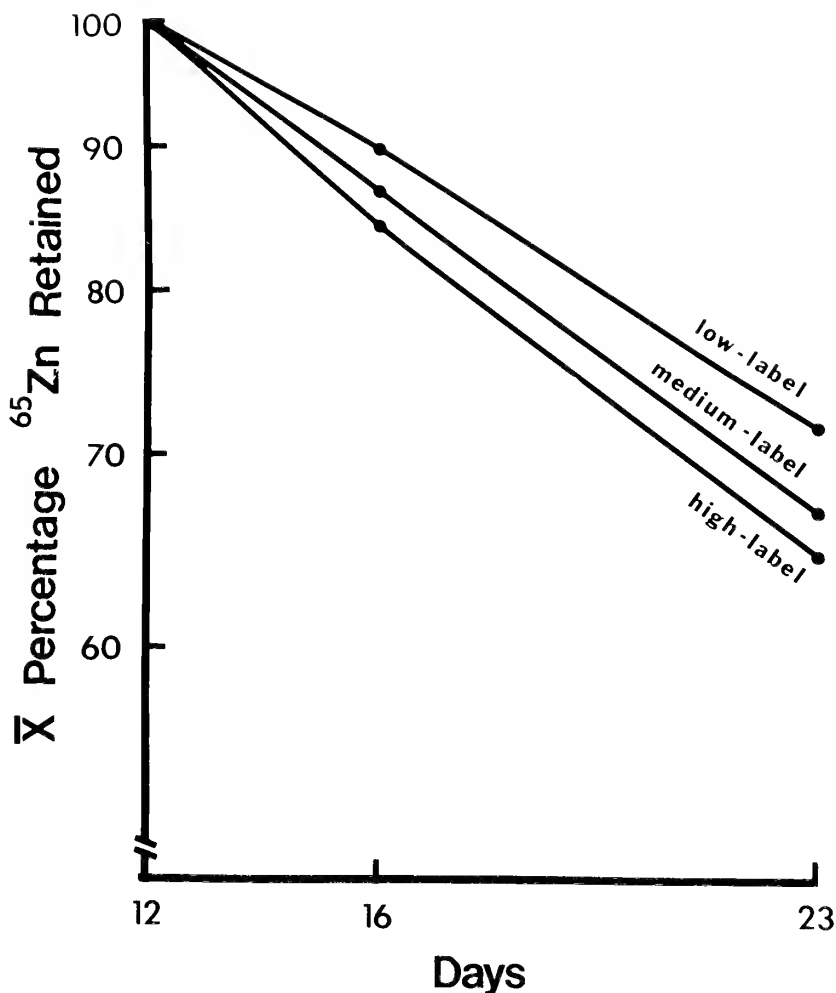
Figure 2. Effect of Label Level on the Bioelimination of ^{65}Zn in
Popilius disjunctus. Day 12 Data are normalized to 100%.

of slopes of the three groups. Analysis revealed that significant
differences among the slopes do exist (F = 10.39, p<.001). Further
analysis by a Fisher's Protected LSD test showed that the slope of
the line representing the low-labeled beetles was significantly less
than any of the other groups (t = 3.50, p<.01). No other statisti-
cally significant differences among slopes existed.

It is clear that label level has an effect on rate of ^{65}Zn excretion in *P. disjunctus*. This finding is important relative to experiments where the rate of nuclide excretion is being used to estimate metabolic rate. In such experiments, where relatively small differences in turnover rates of the nuclide in individual animals may be taken as evidence of metabolic differences, animals must be uniformly labeled.

LITERATURE CITED

Brugh, T.H., and W.H. Mason. 1976. Relationship of radionuclide bioelimination and reproduction rate in *Drosophila melanogaster* (Meigen). Pages 209-216 *in* C.E. Cushing, Jr., Radioecology and energy resources, Special Pub. Ecol. Soc. Am. Dowden, Hutchinson, and Ross, Stroudsburg, Pennsylvania.

Burnett, A.M., W.H. Mason, and S.T. Rhodes. 1969. Reingestion of feces and excretion rates of ^{65}Zn in *Popilius disjunctus* versus *Cryptocercus punctulatus*. Ecology 50:1094-1096.

Crossley, D.A., Jr. 1966. Radioisotope measurement of food consumption by the leaf beetle species *Chrysomela knabi* Brown. Ecology 47:1-8.

Gautney, J.A., W.H. Mason, T.H. Brugh, and F.G. Giesbrecht. 1981. Egg production and bioelimination of ^{59}Fe in *Drosophila melanogaster*. Environ. Entomol. 10:327-331.

Gessamen, J.A. 1980. An evaluation of heart rate as an indirect measure of daily energy metabolism of the American Kestrel. Comp. Biochem. Physiol., 65A, 273-289.

Grant, M., L.C. Wit., and W.H. Mason. 1980. Relationship of ^{65}Zn elimination and oxygen consumption in *Acheta domesticus*. J. Ga. Entomol. Soc. 15:10-19.

Lauhachinda, Nitaya, and William H. Mason. 1979. ^{65}Zn excretion as an indirect measurement of Q_{10} in the isopod, *Armadillidium vulgare* (Latreille). J. Ala. Acad. Sci. 50:27-34.

Mason, W.H., E.M. EuDaly, and P. S-B Chiu. 1976. ^{65}Zn, ^{59}Fe, and ^{54}Mn bioelimination versus egg production in *Heliothis zea*. Pages 217-220 *in* C.E. Cushing, Jr., Radioecology and energy resources. Special Pub. Ecol. Soc. Am. Dowden, Hutchinson, Ross, Stroudsburg, Penn.

Mason, W.H., and K.A. McGraw. 1973. Relationship of ^{65}Zn excretion and egg production in *Trichoplusia ni* (Hubner). Ecology 54:214-216.

Mason, W.H., and P. S-B Chiu. 1976. Photoperiodicity, ^{65}Zn elimination and egg production in *Heliothis virescens*. J. Ga. Entomol. Soc. 11:271-277.

Mason, W.H., and E.P. Odum. 1969. The effect of coprophagy on retention and bioelimination of radionuclides by detritus-feeding animals. Proc. Sec. Nat. Symp. Radioecology. p. 721-724.

Mason, W.H., L.C. Wit, and M.S. Blackmore. 1983. Bioelimination of ^{65}Zn in *Popilius disjunctus* after a dietary zinc supplement. J. Ga. Entomol. Soc. In press.

Nagy, K.A. 1980. CO_2 production in animals: analysis of potential errors in the doubly labeled water method. Am. J. Physiol. 238, R466-R473.

Odum, E.P. 1961. Excretion rate of radioisotopes as indices of metabolic rates in nature: biological half-life of zinc-65 in relation to temperature, food consumption, growth, and reproduction in arthropods. Biol. Bull. 121:371-2.

Odum, E.P., and F.B. Golley. 1963. Radioactive tracers as an aid to the measurement of energy flow at the population level in nature. Pages 403-410 *in* V. Schultz and A. W. Klement, Jr., eds. Proceedings of First National Symposium on Radioecology. Reinhold, New York and AIBS, Washington.

Reichle, D.E. 1968. Relation of body size to food intake, oxygen consumption and trace element metabolism in forest floor arthropods. Ecology 49:538-41.

Reichle, D.E., and G.J. Dobson. 1966. The relationship between metabolism and ^{134}Cs turnover by forest isopods, *Armadillidium vulgare* and *Concilius convexus*. Pages 67-8 *in* USAEC Doc. ORNL-4007 (Oak Ridge National Laboratory, Oak Ridge, TN).

Rhodes, S.T., and W.H. Mason. 1971. ^{65}Zn excretion as an index to metabolic rate in the wood-feeding cockroach, *Cryptocercus punctulatus*. Ann. Entomol. Soc. Amer. 64:450-452.

Schreiber, M.N., and W.H. Mason. 1976. Investigation of coprophagy and fecal pellet selection in the wood-degrading beetle, *Popilius disjunctus* (Illiger). Pages 136-139 *in* C.E. Cushing, Jr., Radioecology and energy resources. Special Pub. Ecol. Soc. Am. Dowden, Hutchinson, and Ross, Stroudsburg, Pennsylvania.

Taylor, P. 1978. Radioisotopes as metabolic labels for *Glossina* (Diptera: Glossinidae) I. Laboratory determination of the relationship between radioisotope metabolism, respiration, and temperature. Bull. Ent. Res. 68:1-9.

Wit, L.C., W.H. Mason, and M.S. Blackmore. 1983. The effects of crowding on the bioelimination of ^{65}Zn in *Popilius disjunctus*. J. Ga. Entomol. Soc. In press.

NOTES

NOTES

NOTES

CONTENTS

LETTERS

THE *JOURNAL* FORMAT
CONTINUES TO EXPAND

This issue of the *Journal* contains the first of our "invited" articles dealing with Science in Alabama. I hope the next issue will include an article describing the Marine Sciences Program at Dauphin Island. Readers who wish to submit suggestions concerning similar topics of general interest should send them to Dr. Ken Francis, Associate Editor, School of Community and allied Health/Division of Physical Therapy, The University of Alabama in Birmingham, Birmingham, Alabama 35294.

Most of the current issue is devoted to the publication of abstracts originating from the 1983 annual meeting held at The University of Alabama. It is clear that much confusion still exists concerning the proper preparation and submission of these abstracts. Several comments concerning abstract submission appear to be in order.

At least one author of each abstract must be a member of the Academy. The presenter of the paper must also be registered for the meeting. The abstract must be forwarded to the editor in the prescribed format in order to be eligible for publication. This year, I have withdrawn 24 abstracts for there being no author who was an Academy member, or because the speaker had not registered (actually, this year the abstract was published if any author on the paper had registered). Eighteen titles were submitted for which I never received an abstract. It may very well be that the authors of all these papers did not wish to have their abstracts published. I hope that is the case.

Another matter that seems important enough to discuss is the preparation of the abstract. We now send abstract forms to the entire membership along with the call for papers. The use of similar forms has become rather standard procedure for most societies that publish abstracts in a proceedings issue. The form contains precise instructions relative to style. The blue boundary lines allow us to photocopy the abstracts without meticulous cutting and trimming. This year more than one-half of the abstracts submitted to me were not on the proper submission forms. Many of them were very poor copies of what appear to be copies. Several of them exceeded the margin restraints. Persons submitted abstracts without any identification as to author affiliation and/or addresses. Some were double-spaced, and some exceeded the one-half page size limit. A few of these were returned to the authors for re-submission. A few were re-typed here in our office. Those with smears and faded-out areas are being published as they were received. There is no way that I can make them look any better than when they arrived. Beginning next year, all abstracts not presented on the appropriate form and in the prescribed style will be returned to the author. Extra abstract forms can be acquired by requesting them from the Secretary or the Administrative Officer.

The Editor

THE RED MOUNTAIN MUSEUM:
A SCIENCE CENTER FOR PUBLIC EDUCATION AND RESEARCH

Whitman Cross II, Executive Director
and
Gorden Bell, Paleontologist
Red Mountain Museum
1421 22nd Street South
Birmingham, AL 35205

INTRODUCTION

Road congestion in the 1960's prompted the Alabama Highway Department to construct a roadway directly through Birmingham's Red Mountain. As the project neared completion, a layer of concrete was planned to cover most of the rock face along the cut. A group of citizens, who realized the potential this cut would provide as an educational tool to illustrate the geologic history of the region, organized a successful campaign to stop the covering of the rock layers. In 1971, the City of Birmingham passed an ordinance creating the Red Mountain Museum as a department of the City.

Figure 1. Museum building with Birmingham in the background.

Today, the museum site consists of approximately 14 acres adjacent to the roadcut on the edge of an older residential community. The physical facilities consist of ten modified residences and an apartment building which is temporarily being used for storage. Altogether, over 12,000 square feet of space are involved in museum activities.

Funding is primarily by the city of Birmingham, with supplements from grants and private donations raised by the Red Mountain Museum Society. Ten of the fourteen staff members are City employees.

PURPOSE OF THE MUSEUM

The Red Mountain Museum is both a museum in the traditional sense and a science center in the modern sense. Through exhibits, collection programs, and research, the museum enhances the quality of life for citizens of northern Alabama in the fields of geology, paleontology, anthropology, astronomy, and environmental awareness. To be successful, museum institutions today must attract visitors repeatedly through changing exhibits, participatory exhibits and activities, educational programs, and recreational facilities.

The Museum is rapidly becoming the center for vertebrate paleontologic research in Alabama through cooperative efforts with the Smithsonian Institution and the colleges and universities in the state. Natural resource corporations and geology departments of many universities visit the roadcut routinely to study one of the finest exposures of Paleozoic history in the United States.

EXHIBITS

The exhibits are developed around two themes:

1. "A Walk Through Time" which starts with the formation of galaxies and our Solar System, and progresses through the physical and biological development of the earth to the end of the paleo-Indian cultures in Alabama.

2. "Environmental Awareness" which is developed through the visitor's viewing of images and data from instruments that record information from both Earth and space. A spectrohelioscope was the first instrument installed and now has become an integral part of the science center.

Other than the spectrohelioscope, all exhibits have been designed, fabricated, and installed by the museum staff. A description of the exhibits follows:

Roadcut

An interpretive walkway, extending 1/4 miles along the Red Mountain Expressway, is 220 feet high and covers approximately 150 million years of Paleozoic history. Signs and cassette

tape-directed tours point out the various features to be seen in the roadcut, such as: faults, folds, joints, solution cavities, fossils, volcanic ash, reefs, iron ore, ripple marks, and unconformities. (It should be pointed out, however, that a slumping of surface material has temporarily closed the roadcut walkway to the general public except for college and professional geology groups.)

Museum Displays

- Six-foot fiberglass model of the sun with a window to the interior.
- Fiber optic model of the galaxy.
- Eight-foot fiberglass model of the proto-earth with a cut-out section showing the interior. Planetesimals hang above.
- Several panels of writing explaining the origin of the solar system and of life.
- Thirty-foot mural painted by the Exhibits Director depicting the changes in landscape and life forms from pre-Cambrian through the Devonian Period.
- Electronic continental drift display showing changes in the shape and position of the land masses through geologic time.
- Modelled section of the roadcut made from actual section of the cut; cut-out spaces exhibit fossils of various types of preservation.
- Three projector, sound-synchronized, animated, audio-visual exhibit utilizing 275 slides and lasting about seven minutes, covering the changes in life from the Mississippian through the Cretaceous (dinosaur) Period.
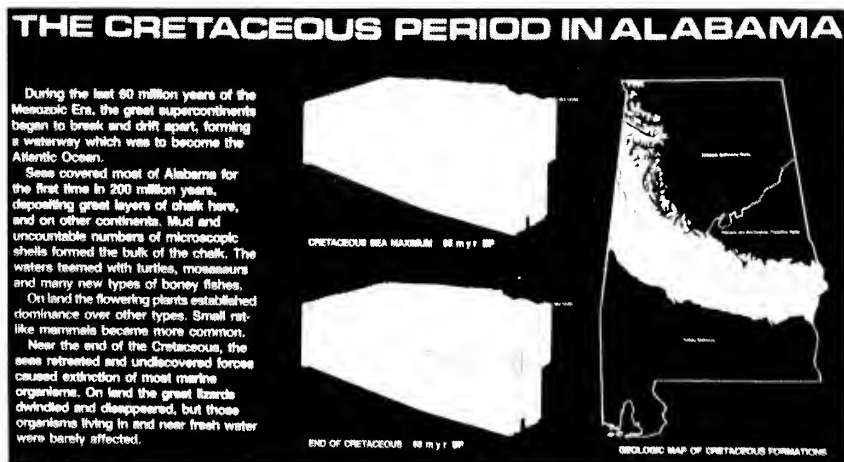
Figure 2. Back-lit transparency display introducing the Cretaceous Period in Alabama.

- Cretaceous exhibit backlit panel illustrating the geologic map of Alabama and locating the best areas for finding fossil materials.
- Case exhibiting Cretaceous turtle and bird materials.
- Mounted 14-foot specimen of a mosasaur with 90% of its original parts.
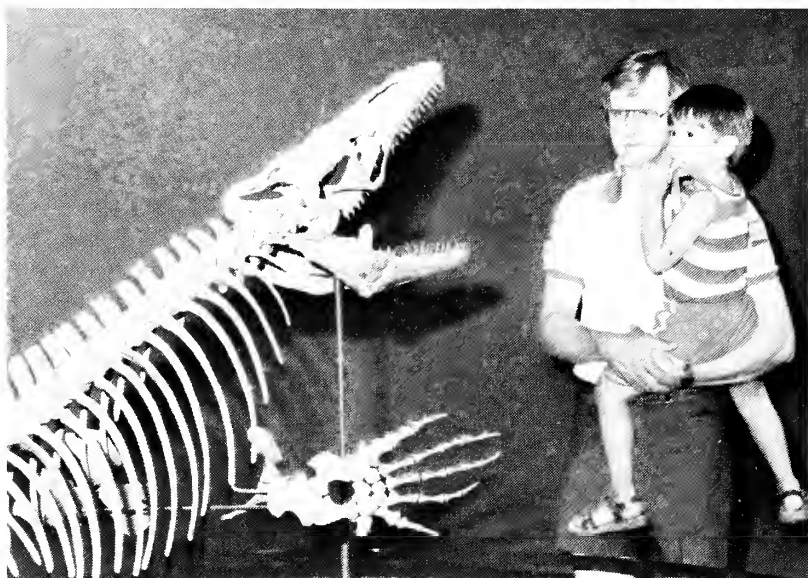
Figure 3. Eighty million year old mosasaur from Greene County.

- Cretaceous fish mounted in simulated rock in relief with back-lit transparencies illustrating the procedure for excavating and preparing the specimen. It is believed to be the most complete specimen in the world.
- Tertiary exhibit mural showing well-known fossil animals, Gulf Coast stratigraphy, fossil invertebrates characteristic of this area, and fossil whale parts.
- Paleo-Indian exhibit consisting of four lighted panels of artifacts and paintings depicting the four periods of paleo-Indian history in Alabama.
- Temporary exhibit case showing various parts of fossil whales in comparison to a man's rib.
- Spectrohelioscope ("solar scope") mounted on a roof turret operated from inside the museum; it tracks the sun remotely throughout the day and presents a detailed image of 1/3 of the solar disk on two black and white TV monitors.

RESEARCH

Research conducted at the Red Mountain Museum is focused in two fields: solar astronomy and paleontology. With the recent installation of the spectrohelioscope, astro-photography will be carried out by the University of Alabama in Birmingham's Department of Physics and Astronomy in conjunction with the Birmingham Astronomical Society to produce a systematic record of solar activity. The spectrohelioscope tracks the sun daily, producing an image of 1/3 of the solar disc on two black and white TV monitors in the museum. Photography utilizes a mounting tube on the instrument, by-passing the TV camera. A hydrogen alpha filter produces an exceptionally clear image of prominences, flares, sunspots, and granular structure. The TV camera produces 1024 lines to the inch and requires special monitors adapted to this output.
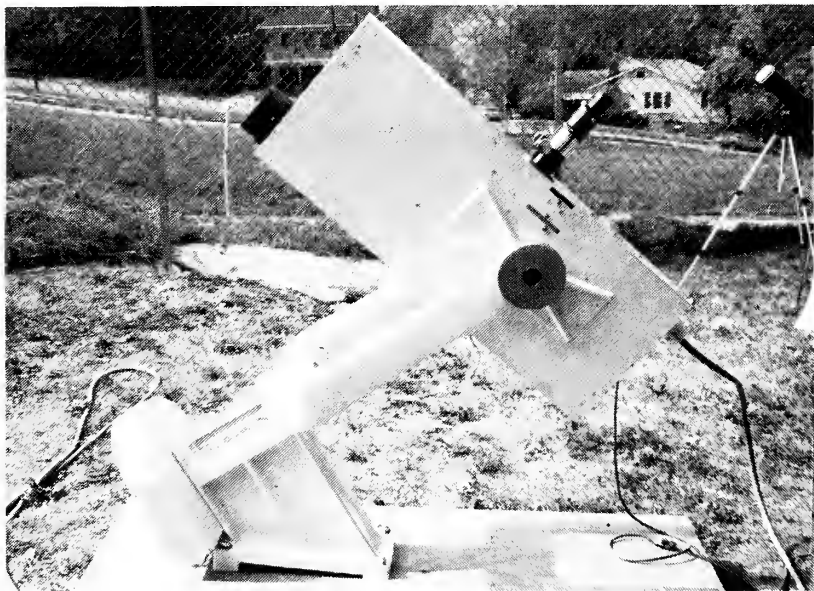
Figure 4. Spectrohelioscope being tested prior to installation.

Research in the field of paleontology is concentrated on the study of Eocene whales and Cretaceous reptiles, turtles, fish, and birds. Around the turn of the century, it was common practice for museums from Europe and North America to build exhibit specimens from unassociated parts that were collected from a variety of locations.

Such practice has caused confusion and misinterpretation. An important contribution of the Red Mountain Museum has been in the proper identification of whales and Holostean fish from the Eocene era, and publishing corrections to rectify the mis-use of previously identified genera and species.

Summer field expeditions run jointly by the Red Mountain Museum and the Alabama Museum of Natural History have produced excellent collections and have provided unique opportunities for teenagers to work with scientists and learn the techniques of field research first hand. During the summer of 1983, there will be two separate two-week field expeditions on archeology and paleontology.

COLLECTIONS

The collections at the Red Mountain Museum consist of approximately 50,000 objects, primarily in the form of fossil and recent molluscs, vertebrate materials (reptiles, whales, fish, birds), and paleo-Indian artifacts. At the present time, less than 5% of the total collection has been cataloged. Significant collection materials include:

1. Cretaceous-
   A. Holostean fish- 95% complete, including first known palatine; contains all parts of the anatomy which have had several names:
      1. Anacistrodon- 1849
      2. Hadrodus-   1857
      3. Grypodus-   1899, to replace Ancistrodon.

      4. Propenser-   1970

   B. Ichthyornis (toothed bird)- better preserved than the type specimens; 30-40 wing bones and 2 partial femora.

   C. Mosasaurs-   commonly reach 50 feet in length, but those found in Alabama are smaller.
      1. Clidastes- Red Mountain Museum display specimen-90% complete; illustrates first evidence of sacro-illiac articulation; infant mosasaur, 35% of specimen recovered representing portions of all parts of the anatomy; much additional material, primarily unassociated.

It is anticipated that research on
very young specimens will provide
evidence as to the reproductive
method used by mosasaurs.

D. Mammals-   several teeth found in NE Missis-
sippi and in an Alabama formation;
bulk   sampling   techniques   are
necessary.

II. Tertiary (Eocene)-
A. Whales-
   1. Basilosaurus - subject of master's thesis at LSU
      for staff paleontologist, Winston Lancaster;
      he studied forelimb function and otic osteol-
      ogy from a Louisiana specimen; in 1982 RMM
      staff excavated a specimen near Millry, Ala-
      bama that is 5% larger than any reported to
      date.
   2. Zygorhiza - excavated in 1980 by staff paleon-
      tologist, Ronald Rhoads, in cooperation with
      Auburn University; another located specimen,
      to be excavated in 1983, may shed light on
      controversy of the existence of one or two
      species.
   3. Pontogeneus - excavation in progress; 37 verte-
      brae (mostly imperfect) are the only parts
      ever found.
B. Other mammals-
   1. Condylarth molar - from the lower Eocene, Hat-
      chetigbee formation, recovered in 1981; the
      oldest known mammal remains in Alabama.
   2. Multituberculate molar.
   3. Sirenian deciduous incisor (Both teeth (2) and
      (3) recovered from previously considered oldest
      mammal site.)

III. Paleozoic Echinoderms-
A. Upper Cambrian "carpoids" - two or three genera
   represented; first from southeast U.S.; being
   studied by University of Texas, Austin.
B. Pennsylvania starfish- one of only two specimens
   from Alabama.
C. Ordovician paracrinoids- previously known only from
   Oklahoma and Virginia.

IV. Other invertebrates-
A. Pennsylvanian crustacean- found by Red Mountain
   Museum Explorer Post; first in southeast U.S.
B. Lower Cambrian worm operculum- first discovery in
   southeast U.S.

An active loan/exchange program with university collections and researchers permits a broad exchange of information and allows Red Mountain Museum materials to receive critical scrutiny.

EDUCATIONAL PROGRAMS

The Red Mountain Museum operates a variety of educational programs staffed by three museum employees and a number of volunteers.

1. School Programs - enrich school curricula through the use of the museum's collections, exhibits, and special equipment. Twelve programs in geology, astronomy, anthropology, geology, and paleontology are regularly scheduled for classes from Kindergarten through junior high school. Special programs are designed as requested for high school and college groups. Of the 42,000 visitors to the museum in FY 1981-82, approximately 30,000 were involved in school programs.

2. Outreach Programs - carry programs into schools, senior citizen groups, and garden and service clubs such as Kiwanis, Rotary, Lions.

3. Exhibits on Loan - Several times a year, the auditorium is the site for temporary exhibits that also serve as a focus for school programs. Most of these exhibits are rented from the American Association of Museums and the Association of Science and Technology Centers.

4. Summer Research Expeditions - each summer, the Science Department conducts a month-long field camp in Alabama for the purpose of finding, collecting, cataloging, and studying fossil materials with the assistance of teenagers who either pay for or receive scholarship aid for attending one week to learn the procedures involved in paleontologic work and to assist the scientists in acquiring new materials.

5. Major Speakers - are brought to Birmingham on an annual basis to take part in three events over one weekend: (a) a public address; (b) a Red Mountain Museum Youth Society program; and (c) a brunch for local scientists to exchange research information at a professional level.

LONG RANGE PLANS

The RMM Society has contracted with E. Verner Johnson and Associates of Boston to coordinate the development of a comprehensive master plan to be completed by the end of 1983. This plan will produce the following information:

1. Statement of purpose, roles, and programs of the museum.
2. Visitation and operating income projections.
3. Capital fund raising projection.
4. Estimated capital and operating budgets, including staffing needs.
5. Conceptual exhibition plan:
    -description of key exhibition elements and exhibition techniques.
    -exhibition floor plans.
    -exhibition construction and installation budgets.
    -color sketches of major exhibits.
6. Conceptual site development and building design plans:
    -schematic site plan.
    -conceptual building floor plans.
    -conceptual building section drawings.
    -description of architectural concepts and recommended building materials.
7. Implementation schedule.
8. Architectural model with slides and pictures for fund raising.

The Red Mountain Museum encourages input from the public as to programs, exhibits, and facilities that would best serve Alabama from a growing museum complex.

ABSTRACTS

Papers presented at the 60th Annual Meeting
University of Alabama
Tuscaloosa, Alabama
March 3-5, 1983

BIOLOGICAL SCIENCES

SURVEY OF ABO AND RH GROUPS: DIFFERENCES FROM NATIONAL NORMS

Dorothy W. McKee. Biology Dept., Auburn Univ. at Montgomery, Montgomery, AL 36193. Diana Duckworth. Dept. of Medical Technology, Univ. of Southern Mississippi, Hattiesburg, MS 39406.

A survey was made of frequencies of ABO and Rh blood types in a sample population of students and employees at Auburn University at Montgomery. These frequencies were compared with two national norms for the population at large in the United States. A significant deviation was found in both instances for both ABO and Rh blood types. Comparison of our data for Caucasians showed no significant deviation from frequencies expected based on another norm in which frequencies for ABO and Rh types were listed by racial groups. Inspection of data indicated that percentages of blood types among Blacks sampled were close to norms given for the Black population. Our results confirm previous observations that national norms are not necessarily valid for predictions of blood type frequencies in a particular community but may be valid in predicting such frequencies in Black or Caucasian groups separately. It follows that consideration of the Black/Caucasian ratio in a given population should be made in predicting expected frequencies of ABO and Rh blood types.

VOCAL SEQUENCES OF ADULT EASTERN GRAY SQUIRRELS

Robert S. Lishak. Dept. of Zoology-Entomology, Auburn University, AL 36849

Alarm calls of adult gray squirrels (*Sciurus carolinensis*) were recorded and analyzed spectrographically. Intraspecific call variation was quantified and mean values for dominant frequency, harmonics, note duration and internote interval were determined. The repertoire of alarm sounds was found to consist of four notes (buzz, kuk, quaa and moan) which are emitted individually, in sequences or combined to produce hybrid vocalizations described as buzz-quaa, quaa-moan, modulated quaa and quaa-kuk.

Abstracts

UTERINE TISSUE IN PREPUBERTAL RATS TREATED NEONATALLY WITH ANTIHORMONES

P. S. Modlin and P. S. Campbell, Dept. of Biological Sciences, Univ. of Alabama in Huntsville, Huntsville, AL 35899.

Previous research in our laboratory has demonstrated that neonatal estradiol benzoate (EB) injection reduces the availability of cytoplasmic estrogen binding sites and estrogen-stimulated metabolic activity in uteri of prepubertal rats (J. Exp. Zool. 214: 345, 1980). The objective of this study was to determine if the nonsteroidal antiestrogens CI-628 and Nafoxidine could block the developmental effects of EB treatment or if they would simulate the effects of EB treatment since each compound possessess both estrogenic and antiestrogenic properties in various circumstances. On day 3 after birth, rats were injected with a single dose of 50 ug Nafoxidine, 50 ug CI-628 or oil vehicle alone, followed by an injection of 100 ug EB or vehicle 24 hours later. Uteri obtained on days 21-23 were assayed for specific cytoplasmic estrogen binding sites or estradiol-stimulated glucose metabolism. Neonatal exposure to EB or CI-628, and the combinations Nafoxidine + EB and CI-628 + EB resulted in a decrease of specific cytoplasmic estrogen binding sites. A reduction in the amount of $^{14}CO_2$ evolved from glucose oxidation in uteri was also observed in all treatment groups with the exception of those receiving a single dose of CI-628. The results suggest that the neonatal administration of Nafoxidine or CI-628 impairs uterine development. Nafoxidine and CI-628 given 24 hours prior to EB offer little or no protection against the disruptive effects of EB neonatal treatment. Additionally, the compounds decrease ovarian weights which we have previously correlated with reduced uterotrophic responses. Thus, both Nafoxidine and CI-628 act as strong estrogen agonists in the neonatal rat.

ACROSIN INHIBITOR-SPERM INTERACTION

Michael Irwin and Gary R. Poirier. Dept. of Biology, Univ. of Ala. in B'ham, Birmingham, AL 35294.

The indirect immunofluorescent technique was used to demonstrate that an acrosin inhibitor originating from the murine seminal vesicle binds to sperm at ejaculation and is removed during residence in the female reproductive tract. Although epididymal sperm are normally not in contact with this inhibitor they do acquire the ability to bind during epididymal transit. The percentage of epididymal sperm binding inhibitor in vitro is concentration dependent. After two hours of incubation of ductus sperm in capacitating medium there is a significant reduction in the ability of these sperm to bind inhibitor. The antiserum to the murine seminal vesicle inhibitor binds to the equatorial region of freshly ejaculated human sperm and to the apical region of rat seminal vesicle tissue. This observation suggest that components of the human and rat reproductive tract are antigentically similar to the acrosin inhibitor from the murine seminal vesicles.

Abstracts

SALT REGUALTION IN ANOSTRACAN CRUSTACEANS.

R. F. Modlin and M. W. Mullen, Department of Biological Sciences, The
University of Alabama in Huntsville, Huntsville, AL. 35899.

Anostracans normally maintain a hypertonic hemolymph. Hemolymph con-
centrations of the major physiological ions are one hundred- to over one
thousandfold greater than found in water of the temporary ponds anostra-
cans inhabit. Concentrations of Na^+, K^+, Ca^{++} and Mg^{++} were examined in
the hemolymph of Eubranchipus holmani from a temporary pond where con-
centrations of the above ions were 0.04, 0.02, 0.05 and 0.04 mM/l, resp-
ectively. To determine how effectively these fairy shrimp regulate
hemolymph salts, specimens of E. holmani were subjected to media more
dilute than their habitat for 2 hrs. Other specimens were also exposed
for a two hour period to Na^+ concentrations about 20X to 250X greater
than found in their habitat. All experimental specimens were acclimated
to, and tested at, 10 C. Ion content was determined via atomic absorp-
tion spectrophotometry. In dilute media hemolymph ion concentrations
did not change significantly. Initially there was a slight loss, but
ion concentrations returned to normal after about 90 min. Exposure to
increased environmental Na^+ resulted in a change in hemolymph Na^+ con-
centration from a normal average of 60 mM/l to 250 mM/l, while the K^+
and Ca^{++} contents in this situation did not differ from the norms.
Results suggest that E. holmani can effectively remove ions from its
environment, but at least in the case of Na^+ it appears to have diffi-
culty ridding itself of excess amounts. Structure of the salt regulat-
ing cells in the gills of anostracans indicate that ion regulation is
directed toward concentrating, rather than removing, salts in the
hemolymph.

A SIMPLE METHOD FOR CHARACTERIZING
THE PATTERNS OF ROOT GROWTH

Olivia A. Campbell. Dept. of Botany and Microbiology, Auburn University
AL 36849. Charles B. Elkins. Agriculture Research Service, United
States Dept. of Agriculture, Auburn University, AL 36849

Characterizing patterns of root growth among treatments, species,
varieties, etc. frequently requires screening a large number of plants.
Growing plants in soil-containing plastic or glass cylinders may be
utilized; however, screening a large number of plants by this method
can be time consuming, may require considerable greenhouse or growth
chamber space, and allows the investigator to observe the pattern of
root growth only as it exists when the experiment is terminated and the
soil is washed from the roots.
    The method described here is relatively simple, compact, and has the
advantage of allowing the investigator to observe root growth at all
stages of development.
    Seedlings are grown in rectangular aluminum frame sections fitted
with polyethylene and sterile water-absorbing layers. This method has
already been valuable in screening a large number of soybean varieties
to determine which of these varieties are best suited for slit tilled
culture.

FATIGUE AND RECOVERY PATTERNS OF WOMEN FOLLOWING
INTERMITTENT ISOMETRIC AND ISOKINETIC EXERCISE

J.M. Manning. Chairman of Research and Fitness, U.S. Sports Academy Mobile, AL 36608. P. Vaccaro and P.R. Gray. Dept. of Physical Education, University of Maryland, College Park, MD 20742.

The purpose of this study was to investigate fatigue and recovery patterns of women following intermittent isometric and isokinetic exercise. Eight members of the University of Maryland Women's volleyball team and eight graduate and undergraduate women served as subjects. All subjects were tested eight times using both the Cybex II and the Baldwin-Lima-Hamilton SR-4 load cell in order to obtain four separate recovery periods for each fatigue pattern. Intermittent isometric and intermittent isokinetic fatiguing exercise involved a four minute bout of knee extensions at a cadence of one every other second. Following each fatigue bout, the subjects relaxed for 4,16,61 or 240 seconds and then contracted again once maximally. Each exercise bout was randomly assigned and was performed on independent occasions with at least 24 hours between testing sessions. A BMD-P3R:Nonlinear Regression Computer Program was utilized to evaluate the intermittent isokinetic and the intermittent isometric fatigue and recovery data for both groups. To analyze the recovery data further, an analysis of variance was computed across six trial levels-initial torque, final torque, and the four observed periods of recovery. Tukey's HSD post-hoc probe was then applied to the data in order to isolate the significant points of difference. Significant intermittent isometric intermittent isokinetic fatigue pattern differences existed between the volleyball team and the graduate and undergraduate women (P$<$0.05).No significant recovery pattern differences existed between the volleyball team and the reference group following intermittent isometric and intermittent isokinetic exercise.

SUCROSE METABOLISM BY SOME SPIROPLASMAS

C. Stevens, Department of Agricultural Sciences, Tuskegee Institute, AL 36088.

R. M. Cody and R. T. Gudauskas, Department of Botany, Plant Pathology, and Microbiology, Auburn University, AL 35849.

When filter-sterilized medium containing sucrose was inoculated with flower spiroplasmas Spiroplasma floricola, brevi, SR-3 and PPS1, and plant pathogens, S. citri and the corn stunt spiroplasma, and the honeybee pathogen, honeybee spiroplasma, only S. floricola, brevi, PPS1, SR-3, showed growth and an acid reaction of the pH indicator in the medium. The filter-sterilized medium before inoculation, gave a negative test for reducing sugars. Sucrase activity was detected in cell suspensions and cell-free extracts of PPS1, SR-3, brevi and S. floricola. It is interesting to note that these spiroplasmas which can metabolize sucrose were originally isolated from surfaces of flowers.

Abstracts

IMMUNODIAGNOSIS OF HUMAN CRYPTOSPORIDIOSIS

William L. Current and Patricia N. Campbell. Dept. of Zoology-
Entomology, Auburn University, AL   36849

Cryptosporidium is a newly recognized zoonotic agent which produces
a short-term gastrointestinal illness in immunocompetent humans and a
prolonged, grave illness in immunodeficient individuals.   Infections
with Cryptosporidium was reported recently in 12 immunocompetent
individuals who had direct contact with infected animals from 3
separate, unrelated outbreaks of calf cryptosporidiosis.   In this
paper, an indirect immunofluorescent (IIF) test was used to
demonstrate antibodies to Cryptosporidium in sera from these 12
immunocompetent individuals and in sera from 6 subjects with acquired
immune deficiency syndrome (AIDS) and persistent cryptosporidiosis.
Marked seroconversion accompanied recovery from infection in
immunocompetent individuals and their IIF titers remained high for at
least one year.   No antibodies to Cryptosporidium were detected in
sera from 2 subjects with hypogammaglobulinemia, normal T-cell
function, and persistent cryptosporidiosis, or in sera from
individuals not exposed previously to Cryptosporidium.   Very little or
no IIF cross reactivity to other coccidian species tested was
observed.   A modification of this IIF procedure using Cryptosporidium
oocysts as antigens is now being tested.   This modified procedure is
much more convenient and also appears to be a specific test for
Cryptosporidium infection.   Application of these IIF procedures along
with recently-developed techniques to detect oocysts in the feces,
should provide the basis for a more accurate assessment of the number
of individuals with previous and active infections of Cryptosporidium.

DEVELOPMENT OF THE VIPERID PARASITE, CARYOSPORA SIMPLEX IN MICE

Steve J. Upton[1], William L. Current[1], Susan M. Barnard[2], and
John V. Ernst[3], [1]Dept. of Zoology-Entomology, Auburn University,
AL   36849; [2]Atlanta Zoological Park, Atlanta, GA   30315: [3]U.S.D.A.
Parasite Research Laboratory, Beltsville, MD   20705.

Mice were inoculated orally with 250,000 oocysts or 60,000
sporocysts of Caryospora simplex, killed at various times between 2
hr. and 70 days post inoculation (PI), and examined for the presence
of extraintestinal development of this snake coccidium.   Parasites
were found only in the connective tissue of the tongue, cheek, and
nose of inoculated mice.   The first recognizable stages were on day 8
PI and consisted of two types of meronts and gamonts (undifferentiated
sexual stages).   On day 10 PI, macrogametes, microgametocytes, and
unsporulated oocysts were found.   Fully mature, thin-walled oocysts
containing eight sporozoites enclosed in a thin, sporocystic membrane
were seen on days 10-16 PI.   Sporozoites excysted from these
thin-walled oocysts, penetrated adjacent host cells, and formed
monozoic cysts (caryocysts) beginning on day 12 PI.   Caryocysts were
present in the connective tissue through the duration of the study,
day 70 PI.

Abstracts

LEUKOCYTE CHEMOTAXIS ASSOCIATED WITH OSTERTAGIA OSTERTAGI INFECTION IN CATTLE

S. Michelle Washburn and P.H. Klesius. USDA-ARS-SR, Regional Parasite Research Laboratory, Auburn, AL   36830

The chemotactic response of peripheral blood neutrophils and eosinophils, and thoracic duct macrophages to Ostertagia ostertagi L$_3$, crude soluble L$_3$ antigen, and supernatants collected from antigen-stimulated lymphocyte cultures was examined using modified Boyden chamber technique. Chemotactic stimulation was evaluated by comparing these agents to positive chemotaxis controls of zymosan-activated normal calf serum and negative controls of tissue culture medium containing 10% normal calf serum. Live, exsheathed O. ostertagi L$_3$ and soluble antigen prepared by freeze-thawing and sonic disruption of L$_3$ were chemotactic for eosinophils, but not for neutrophils or macrophages. Culture supernatants of lymphocytes from O. ostertagi infected and noninfected calves incubated for 24 hours with soluble antigen were chemotactic for all 3 leukocyte populations tested. However, after 3-4 hour incubations, only lymphocyte supernatants from O. ostertagi infected calves were chemotactic for the 3 leukocyte populations. In addition, supernatants of lymphocytes collected from calves infected with Trichostrongylus axei were not chemotactic for neutrophils or eosinophils after 3-4 hour incubations with soluble antigen. These results suggest that O. ostertagi soluble antigen induces the production of antigen-specific chemotactic factor in lymphocyte cultures obtained from O. ostertagi infected calves.

DMSO INDUCTION OF INTRANUCLEAR MICROFILAMENTS IN VAUCHERIA: A COMPARATIVE STUDY WITH CYTOCHALASIN B.

Maria D. Ribadeneira and H.J. Wilson, Department of Biological Sciences, University of Alabama in Huntsville, Huntsville, AL   35899.

Electron microscopic observations of various animal cells treated with 10% DMSO (Dimethylsulfoxide) for 30 minutes have provided evidence that DMSO induces the translocation of cytoplasmic actin filaments into the nucleus where they reassemble to form giant intranuclear microfilaments (IMF). However, it is still not evident whether DMSO is directly involved in the disruption of cytoplasmic actin or in the reassembly of monomers inside the nucleus. Thus, the purpose of this study was two fold: (1) to test the formation of IMF using a plant system, the filamentous freshwater alga Vaucheria sessile, treated with different concentrations of DMSO; and (2) to do a comparative study using different combinations of DMSO and Cytochalaisin B (CB), a drug known to disrupt actin filaments. From our observations it appears that 10% DMSO does induce the formation of IMF in Vaucheria cells. CB added after a 30 minute treatment with 5 and 7.5% DMSO or vice versa, caused no quantitative enhancement or inhibition of the effect. Yet, 10% DMSO together with CB seems to expand microfilament formation to other membrane systems.

CRICKET VITELLOGENIN: BIOCHEMICAL CHARACTERIZATION AND
UPTAKE BY VITELLOGENIC OVARIES.

James T. Bradley, T. G. Dawkins, and H. H. Benford, Dept. of Zoology-
Entomology, and John D. Weete, Dept. of Botany, Plant Pathology and
Microbiology, Auburn University, AL 36849.

Vitellogenin (VG), the blood-borne precursor to major animal egg
yolk protein(s), is termed vitellin (VN) once it is taken up by
developing oocytes. The cricket, Acheta domesticus, possesses two
multisubunit VG's which are electrophoretically and immunologically
indistinguishable from their corresponding VN's. The subunit composi-
tion of each VG and VN was determined by 2-dimensional polyacrylamide
gel electrophoresis, and the pI's of VN I and II were found to be 8.0
and 7.7 respectively. The lipid content of cricket egg yolk lipo-
protein was analyzed. Major fatty acids present in the freely ex-
tractable and the bound lipid fractions were palmitic, stearic, oleic,
and linoleic acid. Phosphorus accounted for 0.59% of the dry weight of
the egg yolk protein.
    Vitellogenin uptake occurs by pinocytosis at the oocyte surface
after the VG has moved across a single-layered follicular epithelium
which completely surrounds each oocyte. Blood protein moves across
this epithelium through spaces between adjacent epithelial cells. The
spaces appear at the onset of vitellogenesis and can be visualized by
trypan blue which itself is sequestered by vitellogenic oocytes in
vivo.

MECHANISM OF SOME OF THE BRADYCARDIAL REFLEXES IN MAN:
IMPLICATIONS FOR CLINICAL MEDICINE

A. W. Faris, Human Performance Lab; William F. Gilley*, Dept. of Health and Physi-
cal Education; Sheldon Gottlieb*, Graduate School, University of South Alabama,
Mobile, AL 36688.

This study investigated the effects of a cold pressor test (CPT) which is associated
with tachycardia and a cold hip bath (CHB) which elicits a bradycardia, upon the brady-
cardia associated with breath-holding (BH) and apneic face immersion (AFI). Nine
healthy volunteers served as subjects. HR and EKG tracings were continuously monitored
in AVF and V_5. Blood pressures were obtained by auscultation. The data indicated that
the average HR decreased significantly ($p < .05$) under all BH and AFI maneuvers. How-
ever, when BH was supervened on CHB, there was no further reduction in HR. The
bradycardia observed with BH was not as marked as it was with AFI. CPT markedly in-
creased HR, however, a simultaneous AFI—CPT manuever resulted in a depression of
the tachycardia associated with CPT. The AFI—CPT HR was significantly greater than
the HR observed with AFI alone, and was significantly less than the resting HR values.
The CHB produced a bradycardia as intense as that of AFI. The CHB-induced bradycardia
was not exacerbated by the supervention of AFI. The CHB did not significantly decrease
the CPT-induced tachycardia. Except for what occurred with CHB alone, all of the pro-
cedures resulted in a significant increase in systolic blood pressure. Since CHB persists for
up to 6 hours, it may be useful in the conversion of supraventricular tachycardias.

INTERACTION OF SELENIUM AND CADMIUM ON DEVELOPMENT OF POND SNAILS

Karol Higgins. Dept. of Biology, Samford Univ., Birmingham, AL 35229

Early cleavage and gastrula embryonic stages of the freshwater snail
Heliosoma sp. were continuously treated with cadmium and selenium solu-
tions to establish lethal concentrations and to determine if any
abnormalities occurred. $CdCl_2$ was tested at concentrations of 10 ppm,
1 ppm, 100 ppb, 10 ppb and 1 ppb. Sodium selenite and sodium selenate
were tested at 100 ppm, 10 ppm, 1 ppm and 100 ppb. All snails died
within 48 hours when treated with 100 ppm selenite and selenate. At
10 ppm and 1 ppm survival improved, but development was delayed. Shell
abnormalities were also observed, accompanied by swelling of the vis-
ceral mass, head and foot. Treatment with 10 ppb and 1 ppb selenite or
selenate resulted in normal development. When treated with 10 ppm
$CdCl_2$ the snails showed delayed development, abnormalities of the shell
foot and visceral mass, and all snails died by day 12. Treatment with
1 ppm and 100 ppb $CdCl_2$ resulted in hatching, but with delayed develop-
ment and occasional swelling of the visceral mass, head and foot.
Shell abnormalities were also present. 10 ppb and 1 ppb $CdCl_2$ resulted
in normal development. In order to determine the combined effects of
Cd and Se on development, snail embryos were exposed to solutions con-
taining a sublethal concentration of 10 ppb $CdCl_2$ in combination with
100 ppm, 10 ppm, 1 ppm and 100 ppb selenite or selenate. In another
experiement snails were allowed to develop in 100 ppb selenate in com-
bination with 10 ppm, 1 ppm, 100 ppb, 10 ppb and 1 ppb $CdCl_2$. In the
1 ppm selenite plus 10 ppb $CdCl_2$ combination, survival increased by 36%
and hatching improved by 30%. However, the percentage of snails sur-
viving to day 20 and the percentage of snails hatching did not seem to
be improved by any other combination of cadmium and selenium.

ISOSPORA SUIS: DEVELOPMENT IN CHICKEN EMBRYOS

David S. Lindsay* and William L. Current. Dept. of Zoology-Entomology,
Auburn Univ., Auburn, AL 36849.

Development of the swine coccidium Isospora suis in embryonated
chicken eggs is described. Approximately 200,000 sporozoites were
inoculated into the allantoic cavity of 10-day-old embyronated chicken
eggs. Allantoic fluid (AF) and portions of CAM were examined at 24-hour
intervals for the presence of living stages of I. suis. At 24 and 48
hr PI sporozoites were the only stages present in the AF and no stages
were observed in the CAM. By 3 and 4 days PI, binucleate Type I meronts
and Type I merozoites were present. Type I meronts underwent repeated
divisions by endodyogeny and produced up to 12 Type I merozoites within
a single host cell. Type I meronts and merozoites were still present 8
days PI. Multinucleate Type II meronts and Type II merozoites were
first seen in AF and CAM 5 days PI. Type II meronts were often seen
in groups of 2-4 per host cell and produced up to 26 Type II merozoites
per host cell. Young sexual stages were seen 6 days PI and mature un-
sporulated oocysts were first seen 8 days PI. The endogenous develop-
ment of I. suis observed in ovo is similar to that occuring in experi-
mentally infected piglets. This study represents the first fully
documented report of complete development of an mammalian coccidium in
chicken embryos.

Abstracts

NUCLEAR WARFARE: POSSIBLE GLOBAL BIOLOGICAL EFFECTS

James T. Bradley. Dept. of Zoology-Entomology, Auburn University, AL 36849.

The purpose of this paper is to call attention to the magnitude of the world's present nuclear arsenals and to the long-term worldwide effects upon the biosphere which can be expected from a major nuclear exchange in the northern hemisphere.

The present combined yield of the nuclear weapons of the U.S. and the U.S.S.R. is about 20,000 megatons (Mt) of TNT equivalent. This approximates 1.6 million times the yield of the weapon detonated over Hiroshima. In 1975, a National Academy of Science Committee to Study the Long-Term Worldwide Effects of Multiple Nuclear-Weapons Detonations released a report (Nat. Acad. Sci. Ann. Rep., 1975. pp. 40-43.) which attempted to predict the effects of a nuclear exchange with a combined yield of 10,000 Mt. The report covered six major areas: atmospheric effects, natural terrestrial ecosystems, managed terrestrial ecosystems, aquatic environment, somatic effects on humans, and genetic effects on humans. Three major causes for long-lasting destruction on a global scale in several of these areas were identified as stratospheric ozone depletion, delayed worldwide fallout, and worldwide cooling.

The author asks the members of the Biological Sciences Section of The AAS to contemplate what there is about our present mode of thinking which threatens life on earth and what specific action might be taken to move us toward a world view within which catastrophe can be averted.

ISOSPORA SUIS IN SWINE: DEMONSTRATION OF IMMUNE REACTIVITY

J.R. Taylor and P.H. Klesius. USDA, Regional Parasite Research Lab, Auburn, AL 36830.D.S. Lindsay and W.L. Current.Dept. of Zoology-Entomology, Auburn Univ., Auburn, AL 36830.

Immune reactivity was evaluated in pigs resistant to challenge with Isospora suis. Cell mediated immunity (CMI) was detected by an agarose plate leukocyte migration inhibition test. Leukocytes from previously inoculated pigs were inhibited from migrating in the presence of I. suis antigens, while leukocytes from uninfected, control animals were not. The CMI response developed two weeks following a primary inoculation of 24-day-old pigs. Leukocytes obtained from pigs at seven weeks post challenge had significantly more positive migration inhibition indices than uninfected pigs. No significant differences in migration inhibition responses of leukocytes from infected animals to either soluble or particulate I. suis antigen preparations were noted. A fluorescent antibody assay was used to measure humoral immunity. The pigs demonstrated IgG antibody to I. suis at three days of age due to colostral antibody absorption. The antibody response decreased in the control pigs until one week following a primary inoculation at 24 days of age. The pigs inoculated at three days of age had an increase in antibody titer three weeks later and it continued to increase after a challenge inoculation.

Abstracts

ELECTROPHORESIS OF ENVELOPE PROTEINS OF *SALMONELLA TYPHIMURIUM*

Shiva P. Singh and Loretta Wilson.* Dept. of Biology, Alabama State
University, Montgomery, AL 36195.

Envelope proteins of *Salmonella typhimurium* were analyzed by two-
dimensional gel electrophoresis. Cultures were grown aerobically in
morpholinopropane sulfonic acid-buffered medium supplemented with
glucose or potassium acetate as carbon source. The envelope was
isolated from exponentially growing cells by sonication and low (12,000
xg, 10 min) and high (100,000 xg, 60 min) speed centrifugations. En-
velope samples were solubilized in sodium dodecyl sulfate (SDS)-urea-
Nonidet-P_{40} mix, and separated by isoelectric focusing in the first
dimension; electrophoresis in the presence of SDS on 8-20% acrylamide
gradient gels separated proteins by molecular weight (MW) in the second
dimension. The envelope proteins were resolved into approximately 125-
150 individual polypeptides ranging in MW from 13,700 to 95,000 daltons.
Majority of these proteins were acidic in nature, being focused at a pH
gradient of 4.5 to 6.5. There were 8-10 major polypeptides; at least
three of these (36,900, 37,500, 48,000) were the most abundant and
common to envelope samples from each carbon source. Differences were
also observed in polypeptide patterns of cells grown in glucose, and
potassium acetate supplemented media. For example, a considerable in-
crease in the intensity of several polypeptides (eg. 22,000, 24,200,
29,600, 35,900, 63,000) was detected in acetate-grown cells. Glucose-
grown cells contained a 95,000 dalton polypeptide which was absent in
acetate grown cells.

LEAD SHOT INGESTION IN A SAMPLE OF ALABAMA MOURNING DOVES

Theodore T. Buerger, Lisa I. Muller, Ralph E. Mirarchi, Michael E.
Lisano. Dept. of Zoology-Entomology, Agri. Exp. Station, Auburn
Univ., Auburn, AL 36849.

The occurrence of ingested lead shot in mourning doves (<u>Zenaida
macroura</u>) is of concern since it may indicate the potential for lethal
exposure to this contaminant. Gizzards were collected from doves
harvested at Eufaula National Wildlife Refuge on three dates (13, 27
October 1979, 5 January 1980) during the Alabama dove hunting season.
A total of 280 males and 241 females was sampled, of which 469 were
juveniles and 52 were adults. Gizzard contents were examined for the
presence of ingested lead shot from spent shotgun shells. One percent
of the doves sampled had ingested lead shot and in all instances a
single pellet was found. There were no differences (P > 0.05) in the
occurrence of ingested lead between ages or sexes, or among collection
dates. Although these data do not indicate a contaminant problem at
Eufaula, which is hunted only 3 times yearly, doves that utilize more
heavily hunted areas in Alabama may have a higher incidence of ingested
lead. Additional studies that sample these areas and investigate the
effects of various agricultural practices on the availability of spent
lead shot are needed. (Supported by Auburn University Grant-in-Aid No.
79-51).

Abstracts

LEUKOCYTE MIGRATION INHIBITION IN CATTLE

William H. Chambers and P.H. Klesius. USDA-ARS-SR, Regional Parasite Research Laboratory, Auburn, AL   36830

A leukocyte migration inhibition (LMI) assay was standardized for use in cattle. The LMI assay was used to detect reactivity to keyhole limpet hemocyanin (KLH) and horseshoe crab hemocyanin (HCH). Calves developed specific reactivity for these antigens and demonstrated occasional nonspecific reactivity. Specific association of LMI reactivity and skin test reactivity (DTH) was found in 8 of 10 calves. There were no nonspecific skin test responses. Experiments were performed to examine the effects of bacterial lipopolysaccharide (LPS) on peripheral blood leukocyte (PBL) cultures and on isolated polymorphonuclear leukocytes as a contributing factor in nonspecific responses. Both inhibition and enhancement of migration was found, dependent upon the concentration of LPS in PBL cultures. LPS-mediated inhibition of migration was eliminated by the addition of polymyxin B in PBL cultures. A second effect of LPS was observed in isolated PMN cultures. LPS induced enhanced migration of PMNs. These results suggest that LPS affects LMI assays in a concentration dependent manner both by the stimulation of lymphokine production by lymphocytes and by a direct activation of PMNs causing enhanced migration. The LMI assay may be useful as an in vitro correlate of DTH reactivity but LPS contamination of biological preparations used in this assay represents a source of error in the proper assessment of immune reactivity.

IN VITRO DEVELOPMENT OF CRYPTOSPORIDIUM SP.

T.B. Haynes and W.L. Current. Dept. of Zoology-Entomology, Auburn Univ., AL   36849

Cryptosporidium is a parasitic protozoan (Phylum: Apicomplexa, Class: Sporozoea, Subclass: Coccidia, Order: Eucoccidiida, Family: Cryptosporidiidae) that has little or no host specificity and often produces a moderate to severe diarrhea in domestic animals and humans. Cryptosporidium is confined to the microvillous border of epithelial cells in the small intestine. Heavy infections produce stunting and fusion of villi. Cryptosporidiosis is often fatal in neonatal animals and immunoincompetent humans, such as individuals with acquired immunodeficiency syndrome (AIDS). Sporozoites excysted from oocysts obtained from humans or experimentally infected goats completed their developmental cycle in human embryonic lung (HEL) tissue culture. Sporozoites penetrated HEL cells within 4 hours of inoculation. Nomarski interference contrast microscopy revealed trophozoites at 4 hours postinoculation (PI), immature Type 1 meronts at 12 hours PI, mature Type I meronts at 16 hours PI, mature Type II meronts at 24 hours PI, macrogametes and microgametocytes at 48 hours PI and oocysts at 72 hours PI. Completion of the life cycle of Cryptosporidium sp. represents only the second reported occurrence of complete development of a coccidian in cell culture and the first outside the genus Eimeria.

Abstracts

REPRODUCTIVE ACTIVITY OF HUNTER-HARVESTED MOURNING DOVES

Lisa I. Muller, Theodore T. Buerger, Ralph E. Mirarchi, and Michael E.
Lisano. Dept. of Zoology-Entomology, Agri. Exp. Sta., Auburn Univ.,
Auburn, AL 36849.

Crops and reproductive organs of mourning doves (<u>Zenaida</u> <u>macroura</u>)
collected at Eufaula National Wildlife Refuge during the Alabama dove
hunting season (10/13/79, 10/27/79, 1/5/80) were examined for breeding
activity. An index of reproductive activity based upon crop and
gonadal data was used to classify doves as successful nesters, imminent
egglayers, potential breeders, marginal breeders (male), and non-
breeders. Total numbers of adult doves examined for the three
collection dates were 17, 7, and 35, respectively. Numbers of
hatching-year doves sampled were 162, 40, and 260, respectively. Re-
productive activity (all categories) was low in both sex and age
classes during the October sampling periods (1.1% and 2.1%, respectively)
but increased (P < 0.05) during January (11.2%). More (P < 0.05) males
than females were reproductively active during the January sampling
period. Breeding activity may be more prone to overlap with late
hunting seasons in milder southern latitudes rather than with early
hunting seasons as is the case in more northern latitudes. (Supported
by Auburn University Grant-in-Aid No. 79-51).

ENDOPARASITES OF SOME GOATS IN ALABAMA AND GEORGIA

J. C. Frandsen and M. Walker. USDA Regional Parasite
Research Laboratory, Auburn, AL 36830.

Fecal samples were collected during the summer of 1982
from 20 herds of goats in east-central Alabama and north-
east Georgia. Approximately 40 per cent of the samples
contained eggs of various species of trichostrongylid nema-
todes. Eggs of the threadworm <u>Strongyloides</u> <u>papillosus</u>
were found in about one-quarter of them, and a few samples,
from herds in Lee County, AL, contained eggs of the whip-
worm <u>Trichuris</u> <u>ovis</u>. Tapeworm eggs (<u>Monezia</u> sp.) were re-
covered from 27 per cent of the samples. The coccidial oo-
cysts recovered belonged to the species <u>Eimeria</u> <u>crandallis</u>
(62.5%), <u>E</u>. <u>arloingi</u> (59.2%), <u>E</u>. <u>parva</u> (57.9%), <u>E</u>. <u>chris-
tenseni</u> (37.5%) and <u>E</u>. <u>intricata</u> (10.5%). Because the
fecal samples were not identified with individual goats,
these data do not reflect parasite prevalence. Even farm-
ers most concerned with production efficiency were gener-
ally ignorant of presence and importance of heavy nema-
tode infections in their animals. This study was sup-
ported in part by the SR-ARS-USDA Research Apprentice-
ship Program.

Abstracts

BIOELIMINATION OF ^{65}ZN AND CROWDING IN *POPILIUS DISJUNCTUS*

Lawrence C. Wit and William H. Mason. Dept. of Zoology-Entomology,
Auburn Univ., AL   36849.

Six groups (solitary males, solitary females, paired males, paired
females, crowded males, and crowded females) of *Popilius disjunctus* were
labeled with ^{65}Zn. Labeled beetles were subsequently evaluated for
whole-body radiation on days 1, 2, 3, 5, 7, 9, 12, 19, and 25 after
labeling. Solitary males excreted the ^{65}Zn more rapidly than did the
other 5 groups of beetles. Such results alert the investigator to the
potential hazards and necessity of rigorous controls when utilizing
heavy metal depletion as an index of metabolic rate.

Use of Sweet Potato Flour as a Carrier for Honeybee Cake

M. A. Wilson, Department of Agricultural Sciences; Tuskegee Institute,
AL 36088.

G. G. Dull, USDA ARS Russell Research Center; Athens, GA 30613 and
J. Lackett, USDA ARS, Bee Breeding Laboratory; Baton Rouge, LA 70808.

Honeybees may be a valuable component of a small farmer's income
and may be used to pollinate fruit and vegetable crops. Bee keepers
in the United States normally feed bees during the winter months with
a commercial soybean bee cake. The objectives of this study were to
determine 1) if sweet potato flour can be used as a carrier for a
honeybee cake; and 2) if honeybees can survive on syrup water without
a bee carrier. Treatments were soybean and syrup, sweet potato and
syrup and syrup only as a control. Sweet potato cake, when fed to
honeybees, showed similar consumption as compared with soybean cake.
Consumption of syrup by bees was greater than sweet potato or soybean
cake. The study evaluation suggests that sweet potato cake may be
used ·as a carrier for honeybees.

A FASTER METHOD FOR OBTAINING LEGUME PROTOPLASTS

Kelly W. Wasmund, and H.J. Wilson. Department of Biological Sciences,
University of Alabama in Huntsville, Huntsville, AL 35899.

Plant protoplasts have been the object of much scrutiny in regard
to their applications in cell wall research, membrane permeability,
virus uptake, and somatic hybridization. The acquisition of legume
leaf protoplasts has met difficulties in quantity and quality of
protoplasts as a result of prolonged exposure to enzymatic digestion.
A highly reproducible procedure is reported for the rapid isolation of
Phaseolus vulgaris L. 'Top Crop' leaf protoplasts. This method
results in a large quantity (7-9 x 10^5) of viable legume protoplasts
within 4-6 hrs. The technique involves use of Rohament P, a pectin
glycosidase, for isolation of individual cells and subsequent use of
Driselase with Macerase for protoplast liberation.

122

Abstracts
HERBICIDE EFFECTS ON GROWTH & RHIZOCTONIA DISEASE OF COTTON

Laurie Hodges and E. A. Curl. Dept. of Botany, Plant Pathology, & Microbiology, Auburn Univ., AL 36849

Herbicides are employed extensively in agriculture for control of weeds, but their effects on nontarget organisms also are of great concern. In laboratory experiments, 'Stoneville 213' cotton seeds were pre-germinated in the emulsifiable concentrate formulation of alachlor (Lasso® 4E) or metolachlor (Dual® 8E) at 10^{-4} M, 10^{-5} M, and 10^{-6} M active ingredient. For each herbicide as the rate increased, early root elongation decreased linearly. Herbicides did not affect seed germination or emergence. When 3-day-old pre-germinated seedlings were transferred to sterile Decatur silty clay loam inoculated with a mycelial suspension of Rhizoctonia solani, only those treated with alachlor at 10^{-4} M showed significant increase in seedling disease susceptibility. Alachlor at 10^{-4} M also significantly reduced plant height and the dry weight of roots and shoots 14 days after treatment. However, alachlor at 10^{-6} M significantly reduced seedling susceptibility to Rhizoctonia. Seedlings treated with metolachlor at the three rates were not different from the control plants 14 days after treatment.

MANAGEMENT OF THE SOYBEAN LOOPER ON ALABAMA SOYBEANS

Linda Jean Mason and T.P. Mack. Dept. of Zoology-Entomology, Auburn Univ., Auburn, Al. 36849.

The soybean looper (Pseudoplusia includens) can be a serious defoliator of soybeans in Alabama. With the cost for soybean production increasing at a past pace, soybean growers must use all possible ways to cut costs without sacrificing yields. These areas include (1) using the plant's ability to compensate for foliage loss, (2) using beneficial insects, (3) using insect diseases, (4) effective anti-pest cultural practices,(5) scouting field and treating only at economic thresholds, and (6) making insecticide treatments count by using correct chemical for pest or group of pests present in the fields.

GEOGRAPHIC COMPARISON OF SPERMATOGENESIS IN THE FENCE LIZARD

McKinney, Rosie B. and Ken R. Marion. Dept. of Biology, University of Alabama in Birmingham, Birmingham, AL 35294.

The seasonal spermatogenic cycle of the fence lizard Sceloporus undulatus from north-central Alabama was observed and compared to that of S. undulatus from Missouri (Marion, 1982, Herpetologica 38:26). Maximal spermiation occurred from March-May in Alabama populations and from April-June in Missouri populations. Minimal testicular mass was noted in August in Alabama males and in July in Missouri males. Testicular recrudescence had begun in late July-August in both populations. Albama males, however, acquired spermatids and a few developing spermatozoa in their testes in November, whereas this was achieved in October in Missouri males. The results are discussed in relation to environmental factors controlling the testicular cycle.

Abstracts

DIETARY ZINC SUPPLEMENTS AND BIOELIMINATION OF ^{65}ZN IN *POPILIUS DISJUNCTUS*

William H. Mason and Lawrence C. Wit. Dept. of Zoology-Entomology, Auburn, Univ., Auburn Univ., AL 36849.

The normal decaying wood diet of *Popilius disjunctus* was supplemented with zinc (zinc chloride) for 17 days prior to being labeled with ^{65}Zn. Labeled beetles were held individually on screens for 25 days with whole body measurements of ^{65}Zn taken on days 1, 2, 3, 5, 7, 9, 12, 15, 18, and 25. Beetles receiving dietary zinc supplements excreted more of the ^{65}Zn and exhibited less individual variation in their excretion patterns than did controls. These results identify a major source of controllable variation in ^{65}Zn excretion patterns in *P. disjunctus*. Exposing experimental animals to an unlabeled zinc supplement prior to labeling should strengthen the correlation between ^{65}Zn elimination and certain metabolic events, making the use of ^{65}Zn turnover rate a more dependable tool in the circuitous measurement of metabolism.

BEAN LEAF BEETLE AND THREECORNERED ALFALFA HOPPER CONTROL

W. Mitchell Rohlfs, and T. P. Mack. Dept. of Zoology-Entomology, Agric. Exp. Station, Auburn Univ., AL 36849

The effectiveness of foliar insecticides in controlling bean leaf beetle and threecornered alfalfa hopper (TCAH) on soybeans was tested at the Blackbelt Substation of Auburn Univ. at Marion Jct., AL. Ten treatments and an untreated check were replicated 4 times in a randomized complete block design. Plots were sprayed with a CO_2 backpack sprayer and sampled with beat sheets 24h, 72h and 1 week postspray. At 24h postspray, all products tested except the fungicide Super-tin significantly reduced bean leaf beetles and small TCAH. Lannate, Ambush, Ammo and S3206 reduced medium TCAH populations while only Lannate and S3206 reduced large TCAH at the 24h sample. At 72h, all treatments except Super-tin significantly reduced bean leaf beetle and all sizes of TCAH. Very few differences existed between treatments. These treatments continued to control both species at the 7 day sample.

SEASONAL OVARIAN AND STEROID CYCLES IN THE FENCE LIZARD

McKinney, Rosie B. and Ken R. Marion. Dept. of Biology, University of Alabama in Birmingham, Birmingham, AL 35294.

Older female fence lizards, Sceloporus undulatus, from north-central Alabama had at least 3 clutches per season. Eggs were oviposited in May, June, and July. Most yearlings had 1-2 clutches per season. Seasonal changes in plasma estrogen (E), progesterone (P) and testosterone (T) were correlated with reproductive events. Plasma E levels were slightly elevated during the luteal phases of the first two clutches and peaked during the last clutch. Plasma P and T were low but increased during the last clutch. Preovulatory surges of plasma E, P, and T were observed in yearling females captured in July. Whether similar surges occur with each clutch is unknown. Steroid levels were minimal during brumation.

A SIZE–REFUGE OF DONAX DOROTHEAE FROM JUVENILE POMPANO

Gerald T. Regan and Edward J. Barranco *. Department of Biology, Spring Hill College, Mobile, AL 36608.

Having observed by SCUBA diving that surf clams *Donax dorotheae* were eaten by Florida pompanos, *Trachinotus carolinus,* we measured in the laboratory the smallest clams rejected by pompanos of given lengths. We collected specimens at Dauphin Island in the summer and followed Modde (1980, Gulf Res. Reports 6:377-385) in recognizing the pompanos as juveniles (SL range 2.2 - 6.8 cm). We put one clam at a time into an aquarium with one fish in it. We retrieved and measured the length of all clams spit out by the fish and then measured the fish, X (N=20). The length of the smallest clam to escape being eaten, Y, is predicted by

$$Y = -2.1 + 2.4X - .28X^2 + .01X^3$$

Observed Y ranged from 2.0 to 5.0 mm with one outlier at 6. We opened 90 clams ranging from 3.0 - 11.5 mm and saw no eggs in any smaller than 5.0. The Dauphin Island Sea Lab and Spring Hill College helped support this work.

BIOLOGY AND CONTROL OF EUONYMUS SCALE IN ALABAMA

Michael L. Williams, Dept. Zoology-Entomology, Auburn University, AL, 36849.

The euonymus scale, Unaspis euonymi (Comstock), is a major pest in all temperate regions of the world except Australia. This armored scale insect is very common in Alabama, often causing complete defoliation or death to numerous varieties of evergreen euonymus. Research at Auburn, has shown that the cultivars Euonymus alata 'Compacta', E. fortunei 'acuta' and E. kiautschovica are resistant to attack by euonymus scale. In Alabama the euonymus scale goes through the winter as fertilized adult females. The eggs are laid in early spring and usually hatch during late March. The newly hatched "crawlers" move to other parts of the plant, settle and begin to develop waxy coverings. There are three generations a year in Alabama. Crawlers emerge in March, June and August. Insecticide applications for control of euonymus scale should be applied during crawler emergence periods and should be repeated at 10-day intervals for three treatments.

BIOCHEMICAL AND ULTRASTRUCTURAL ASPECTS OF THE FASTIDIOUS PROKARYOTE Spiroplasma citri

K.M. Franklin and H.J. Wilson. Department of Biological Sciences, University of Alabama in Huntsville, Huntsville, AL 35899.

Spiroplasma citri is a motile, helical plant pathogenic mycoplasma. Two strains, ASP-1 and BR6-3X, have been studied using transmission electron microscopy. ASP-1 is a non-helical variant, measuring 2-8 m in length and 0.15 m in width. BR6-3X has a helical morphology, measuring 3-10 m by 0.2 m. Additionally, BR6-3X is infected with virus-like particles 40-50 nm in width with short tails of 12-20 nm. Thin sections of both strains reveal a filamentous element with lateral arms traversing the length of the organism. This element undergoes condensation when organisms are treated with the chemicals dueterium oxide, vinblastine sulfate, and/or dimethyl sulfoxide. These agents also affect a loss of motility and helical or filamentous shape. ASP-1 and BR6-3X are not morphologically affected by cytochalasin B, colchicine, or EDTA.

Abstracts

CHEMISTRY

SYNTHESIS AND ANTIFOLATE ACTIVITY OF 7,8-DIHYDRO-N10-(PROPARGYL)-
FOLIC ACID. A SYNTHETIC SUBSTRATE OF DIHYDROFOLATE REDUCTASE

M.G. Nair, University of South Alabama, College of Medicine, Mobile,
Alabama 36688; R.L. Kisliuk and Y. Gaumont, Tufts University School of
Medicine, Boston, Massachusetts

Synthetic substrates of dihydrofolate reductase (DHFR) capable of
metabolic activation to antimetabolites in vivo are potentially useful
chemotherapeutic agents for treatment of tumors which overproduce this
enzyme. Several synthetic substrates of DHFR which are close analogues
of 7,8-dihydrofolic acid have been previously synthesized and evaluated
in this laboratory. As a continuation of this program, 7,8-dihydro-N10-
(propargyl) folic acid (l) has been synthesized by two distinctly differ-
ent chemical routes.
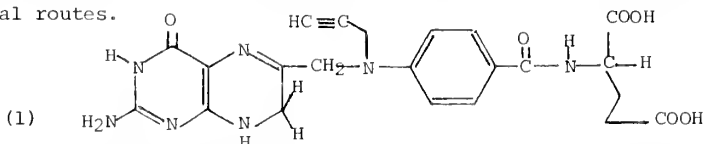
Compound (l) was found to be a good substrate of *L. casei* dihydrofolate
reductase (relative rate $\geq$50% of natural substrate) and an excellent
inhibitor of the growth of *S. faecium* (I_{50}=0.13x10^{-9} g/ml). The enzy-
matically activated derivative of (l) was substantially more active (I_{50}
=0.08x10^{-9} g/ml) than the parent compound in its growth inhibitory
potency against *S. faecium*. Selected derivatives of (l) were also
evaluated in related biological test systems. From these results, it
was concluded that the biological potency of (l) was sufficiently
interesting to warrant its further evaluation utilizing mammalian cells
in culture and tumors in vivo. Supported by NIH CA-27101.

CELLULOSE HYDROLYSIS WITH NONCONVENTIONAL ACID CATALYSTS

Michael B. Moeller. Department of Chemistry, University of North
Alabama, Florence, AL 35632.

Cellulose waste can be hydrolyzed to produce sugars which have a
commercial value many times greater than the cellulose feed stock.
Most of the commercial processes, either proposed or operating,
use dilute sulfuric acid to catalyze the hydrolysis, although
alternative catalysts have been suggested. We are studying the
hydrolysis of cellulose at high temperatures in solutions of
weak acids. Our objective is to find a system in which the acid
catalyst can be recycled rather than neutralized and discarded.
We have investigated a variety of systems and our preliminary
results look promising although there are indications of
complications in the relevant reactions. Ultimately we hope to
gain enough understanding of the cellulose hydrolysis reaction
mechanism to design a specific catalyst.

Abstracts

A GENERAL SYNTHESIS AND BIOLOGICAL ACTIVITIES OF CERTAIN
QUINAZOLINE INHIBITORS OF THYMIDYLATE SYNTHASE

Eleanor Braverman, Nitin Nanavathi and M.G. Nair, Department of Biochem-
istry, University of South Alabama, Mobile, Alabama 36688

The excellent antileukemic activity of N^{10}-(propargyl)-5,8-dideaza
folic acid (1) has been reported recently by Jones and coworkers. A
close analogue of (1), N^{10}-(cyanomethyl)-5,8-dideaza folic acid (2), has
been synthesized and biologically evaluated in this laboratory. Both
compounds (1) and (2) are good inhibitors of thymidylate synthases de-
rived from various species and show good activity against L1210 cells in
culture. As part of a program directed toward developing coenzyme class
inhibitors of thymidylate synthase for use as anticancer agents, we were
interested in the general synthesis of various analogues of (1) and (2).
A new route to the preparation of the key intermediate, 2-amino-6-
(bromomethyl)-4-hydroxyquinazoline (3) has been developed.

(1) R = -$CH_2C\equiv CH$ (4) R = -CH_2—◁
(2) R = -$CH_2C\equiv N$

(3)
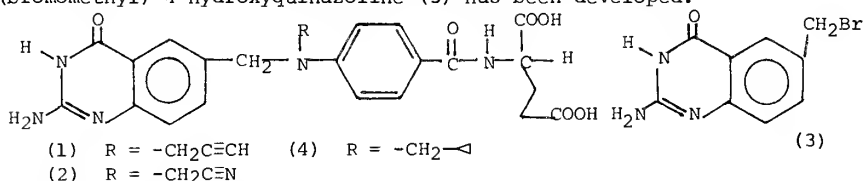
Reaction of various N-monoalkylated diethyl-p-aminobenzoyl-L-glutamates
with (3) gave the diethyl esters of the desired final products, which on
hydrolysis gave the target compounds. One of these compounds was N^{10}-
(cyclopropylmethyl)-5,8-dideaza folic acid (4). The biological activi-
ties of this compound were determined using two folate requiring micro-
organisms and related biological test systmes.

AN ESR STUDY OF A RADICAL IN CONDUCTING P-TERPHENYL CRYSTALS

Thomas W. Robinson* and Lowell D. Kispert. Dept. of Chemistry,
University of Alabama, Tuscaloosa, AL 35486.

Reactions of Lewis acids, such as AsF_5, with the polymer poly-
paraphenylene forms conducting polymers from the normally insulating
materials. Our motivation for studying these materials is the possibility
of producing synthetic metals, which may be used in the electronics
industry. In an effort to understand the step by step radical processes
that occur upon formation of the synthetic metal, we are studying the
reaction of a model system, p-terphenyl (PTP) and AsF_5, in an attempt to
determine the radical intermediates involved in the reaction. We seek a
more detailed understanding of the reaction mechanisms so that better
materials can be synthesized. PTP was selected as the monomer for study.
A single crystal was slowly reacted with AsF_5 gas under vacuum at -106°C.
The PTP was allowed to partially react so it would retain its crystal
structure. ESR analysis shows that g anisotropy exists in the sample.
The minimum g value was determined to occur perpendicular to the crystal
face. The value determined was 2.0019 along the (0, 0, 1) axis. This
direction forms an angle of about 40° with the plane of the benzene rings
suggesting a radical structure composed of a complex between the AsF_5^-
and aromatic cation.

NUCLEIC ACID ANALOGS USING A
PEI-OXAZOLINE COPOLYMER BACKBONE

Joel McCloud Jr. and Adriane G. Ludwick, Dept. of Chemistry, Tuskegee Inst.,
Tuskegee Inst., AL 36088.

A linear water-soluble copolymer **1** has been synthesized by the partial hydrolysis of poly(ethyloxazoline) in acidic solution. A nucleic acid base derivative containing thymine has been synthesized and grafted to the copolymer with the aid of dicyclohexylcarbodiimide. The grafted analog **2** has been characterized

$$\{N-CH_2 CH_2\}\{N-CH_2 CH_2\} \qquad \{N-CH_2 CH_2\}\{N-CH_2 CH_2\}$$

1   **2**

where structure 1: $C=O$, CH_2, CH_3 branches with 0.3 H and 0.7; structure 2: $C=O$, CH_2, CH_3 and 0.3 $C=O$, $H-C-CH_3$, thymine, 0.7
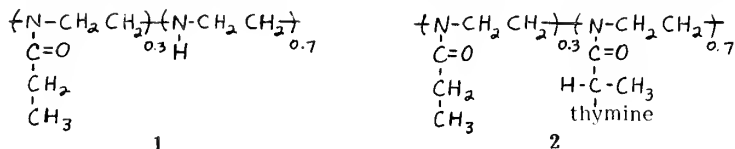
by ^{1}H NMR. The impure analog appears to be at least partially water soluble. Purification of the analog is in progress. Following hypochromicity studies and an elemental analysis, this analog will be tested for biological activity. Synthesis of a branched water-soluble backbone **3** is also in progress. This

$$\{N-CH(CH_3)CH_2\}_x \{N-CH(CH_3)CH_2\}_y$$
with $C=O$, CH_3 and H

3
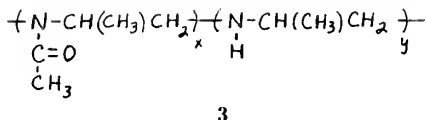
work is supported by NIH/MBRS.

CHARACTERIZATION OF NITROGENASE

J. Rawlings, Physical Sciences Dept., Auburn University at Montgomery,
Montgomery, AL 36193

The iron-molybdenum protein of nitrogenase is a complex metalloprotein that has not yet been completely characterized in terms of the types of metal centers that are present. In part, this results from a lack of physical methods to probe the different types of metal clusters. The absorption spectrum is relatively featureless, and although the EPR signal is distinctive, it only monitors one type of cluster in the protein. Mössbauer studies and solvent perturbation work clearly indicate that one other type of cluster, the P-cluster, is present in the iron-molybdenum protein. By studying the various redox states of the protein, we have shown that the visible circular dichroism spectrum arises primarily from these P-clusters. Redox titrations have quantitated these clusters, and the redox kinetics on these clusters have been studied. Thus, circular dichroism is a useful physical probe that can monitor the states of these otherwise hard to characterize clusters.

THE SYNTHESIS OF POLYNUCLEOTIDE ANALOGS
WITH A PEI BACKBONE

Kenneth S. Robinson and Adriane G. Ludwick, Dept. of Chemistry, Tuskegee Inst., Tuskegee Inst., AL 36088.

In the synthesis of the polynucleotide analog **1** several methods were employed for grafting the nucleic acid base containing pendant to the poly(ethylenimine) (PEI) backbone. These involved the use of a p-nitrophenyl ester, a

$$-N-CH_2CH_2-$$
$$\underset{|}{C}=O$$
$$(CH_3)_2CH-\underset{|}{C}-H$$
$$uracil$$
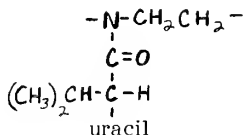
1

chlorobenzotriazole derivative (CBSCBT), and dicyclohexylcarbodiimide (DCC). All three methods could be done at room temperature. In the grafting procedure using the p-nitorphenyl ester method, the disadvantage was the moisture sensitivity of the active ester. Nevertheless, a pure, 100% grafted analog was obtained by this approach. When CBSCBT was used as the grafting agent, an insoluble, difficult to analyze product was obtained. In using DCC it was inferred from TLC results that the analog contaminated with DCC and dicyclohexylurea was obtained. Purification by column chromatography is underway. This work is supported by NIH/MBRS.

ESR STUDIES OF SPIN LABELS DISSOLVED IN LIQUID CRYSTALS

Glenn Allison* and Lowell D. Kispert. Dept. of Chemistry, University of Alabama, Tuscaloosa, AL 35486.

Nitroxide spin labels have been used extensively in the structural study of macromolecules by EPR spectroscopy. In hopes of further characterizing the spin label EPR spectra obtained in these systems as a function of a known host media, a study is currently underway to determine the molecular motion that a spherical, long chain, and a high molecular weight spin label will undergo in a one and two dimensional viscous media. The spherical spin label chosen was tempone. The long chain spin label was tempo stearmide and Molecular Probe #507 was chosen as the high molecular weight spin label. The nematic liquid crystal p(p-ethoxyphenylazo)-phenyl undecylenate (I), the smectic liquid crystal N,N'-bis(4-octyloxybenzylidene)-p-phenylene diamine (II), and chloestryl erucate (III) were used as solvents. The EPR spectrum of tempone in liquid crystal II varied from that of a powder pattern at 35°C to that of an isotropic spectrum at 170°C. Various other dynamic ranges of motion were found in the remaining samples studied.

SULFURANES WITH AMBIDENT LIGANDS

Mark D. Eggers and P. D. Livant, Department of Chemistry, Auburn University, Auburn University, AL 36849

The novel syntheses of sulfuranes 1 a-d are described. The IR spectra of 1b-d are discussed and preliminary structural conclusions are drawn by comparison with appropriate phosphorus and tellurium compounds. The ^{1}H NMR spectra of 1a-e in CH_2Cl_2 and C_6D_6 are discussed. The chemical shift differences of 1a-e in these solvents is proposed as a probe of the polarizability of the hypervalent bond.
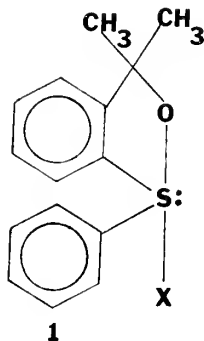
1 a, X = OCH_3
1 b, X = NCS
1 c, X = CN
1 d, X = NCO
1 e, X = Cl

1

KINETICS OF Cu(II) CATALYZED BY H_2O_2 OXIDATION OF RESORCINOL

Niki OQuist and R. H. Dinius, Dept. of Chemistry, Auburn University, Auburn University, AL 36849

The kinetics of the peroxy-oxidation fo resorcinol (1,3-dihydroxy-benzene) with copper(II) as the catalyst was studied. The oxidation of resorcinol was carried out using H_2O_2 as the oxidant at high pH values, i.e. pH 10.7 and 12.7. Copper(II) was used as a catalyst in varying concentrations. The progress of the reaction was followed spectro-metrically. The results seem to indicate that with copper(II) as a catalyst the rate of equation for the reaction will be zero order with respect to resorcinol, first order with respect to hydrogen peroxide and in the range of second to third order with respect to copper(II). Not only does the reaction rate depend on copper(II) concentration but also the degree of completion. This is tentatively interpreted to indicate that copper(II) is converted to a form that is not effective as a catalyst as the reaction proceeds.

SYNTHESIS OF SUBSTITUTED MONO AND DIFLUOROBENZENETRICARBONYLCHROMIUM
COMPLEXES

Christopher A.L. Mahaffy, Auburn University at Montgomery, Montgomery,
Alabama   36193

A new and much improved synthesis for arenetricarbonylchromium
complexes has recently been described [1] whereby the complex may be
made using a very simple reflux arrangement instead of the older and
much more elaborate Strohmeier Apparatus. The new mixed solvent sys-
tem also represents a great improvement over older solvent systems
e.g. diglyme.

$$\text{Arene} + Cr(CO)_6 \xrightarrow[\substack{\text{simple reflux} \\ \text{under } N_2 \quad 30 \text{ hours}}]{\text{THF: } nBu_2O::1:10} \text{Arene } Cr(CO)_3 + 3CO$$
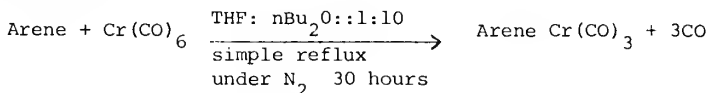
Recently, a number of hitherto unknown mono and difluorobenzene-
tricarbonylchromuim complexes have been synthesised by the improved
method including the $Cr(CO)_3$ complexes of all three isomers of fluo-
rotoluene, fluoroaniline, and fluoroanisole together with the com-
plexes of 3-fluoro-1,2-dimethylbenzene and 2,5-difluoroaniline.   The
last mentioned complex is unique in that it represents the first time
more than one halogen has been attached to the aromatic ring in an
arenetricarbonylchromium complex.

[1] C.A.L.Mahaffy, P.L.Pauson _Inorg._ _Syn._ 1978, _19_, 154

.

CHEMICAL DYNAMICS STUDIES OF SUBSTITUTED
AMINOARSOLANES

Ravindra K. Kanjolia, Charles L. Watkins, and Larry K.
Krannich. Dept. of Chemistry, Univ. of Ala. in
Birmingham, Birmingham, AL 35294.

The H-1 and C-13 nmr spectra have been obtained and
analyzed at various temperatures, in several solvents,
and at specific concentrations for two homologous series
of substituted aminoarsolanes,
$OCH_2CH_2OAsNR_2$ and $OC(CH_3)_2C(CH_3)_2OAsNR_2$.
These spectral data will be discussed. In contrast
to our previous study of the chloroarsolanes, no
significant conformational averaging of the ring protons
is observed. No inversion about the arsenic, nor
intermolecular amino group exchange occurs. The proposed
structure will be discussed in terms of the nmr data.

Abstracts

INDUSTRIAL HYGIENE SAMPLING OF ORGANIC CHEMISTRY TEACHING LABS

Thomas Pierce and Sharon McDonald, Department of Chemistry, Univ.
of North Alabama, Florence, AL 35632

Despite current interest in toxicologic properties of laboratory
materials there remains limited information in the literature
concerning expected levels of representative contaminants that may
be encountered in common laboratory experiments. It is suspected
that many surveys have not found their way into the chemical lit-
erature. One widely quoted study (Hertlein III, F. 'Monitoring
Airborne Contaminants in Chemical Laboratories' in Analytical
Techniques in Occupational Health Chemistry, AGS, 1980) indicates
common air contaminants expected are well below occupational standards
even assuming full-day exposures were to occur. This work generally
confirms these earlier findings except for a result involving a
contaminant with a particularly low permissible exposure level.
Benzene exposures may pose a problem whenever this material is used
in other than 'totally enclosed' conditions. There also appear to
be very low levels of diethyl ether present in this organic chem-
istry teaching laboratory even when no work is being conducted.
The present study is intended not only to document exposure levels
but to suggest an alternative solution to laboratory monitoring.
This study serves as a pilot experiment indicating the practicality
of chemistry students learning how to perform industrial hygiene
sampling and analytis in their own laboratories.

CONFORMATION AND DONOR-ACCEPTOR GHEMISTRY OF MEDIUM-RING DIAMINES.

P. L. Livant and A. W. Majors, Department of Ghemistry, Auburn Univer-
sity, Auburn University, AL 36849

The photoelectron spectrum of 1 shows a single band corresponding
to ionization from two equivalent non-interacting lone pair orbitals
(IP=8.02 eV). However, in 2, the lone pair band is split into a doub-
let, separation 0.70 eV, indicating a sizeable nitrogen - nitrogen in-
teraction. Evidence will be presented which suggests that this inter-
action is mainly through space. This indicates a rather profound effect
of the gem-dimethyl groups on the conformation of the eight-membered
ring. Some of the chemistry of 2 will be presented, including a dis-
cussion of the dynamic behavior of $2 \cdot (BH_3)_2$.

1   2
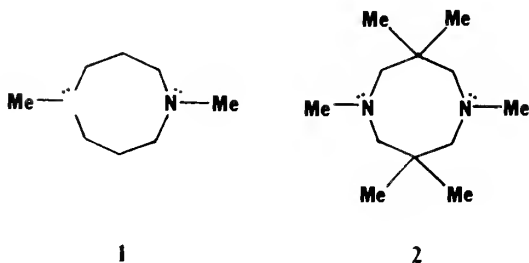
A.C. CONDUCTIVITY OF HETEROGENEOUS POLYCRYSTALINE AgBr

L. K. Pledger and R. H. Dinius. Department of Chemistry, Auburn University, Auburn University, AL 36849

The following expression has been proposed for the electrical conductivity of polycrystalline silver bromide

$$X = (Ae^{-w/2kT} + KS)e^{-U/kT}$$

in which S is the magnitude of the active surface. When KS >> Ae^{-w2kT} a low temperature kind of conductivity predominates which is related to the macroscopic structure of the polycrystalline conductor. In an effort to investigate the nature of this "active surface" A.C. conductivity-temperature curves of heterogeneous polycrystalline AgBr-KBr and AgBr-NaBr were determined. At low concentrations of NaBr and KBr (approximately 1%) conductivities increase 3 to 4.5 fold at higher concentrations (> 10%) conductivities decrease.

HYDROGENATION REACTIONS IN A WATER PHOTOLYSIS SYSTEM

Thomas R. Webb and Chee-Kai Tan, Dept. of Chemistry, Auburn University, AL 36849

Hydrogenations of unsaturated compounds have been studied in a water-photolysis system consisting of $Ru(bipy)_3^{2+}$, MV^{2+}, and colloidal metal (platinum, rhodium, or palladium). Product analysis by gas chromatography and mass spectrometry indicates that many alkenes and dienes are hydrogenated; examples include cyclohexene, styrene, acrylonitrile, cyclohexenone, cyclohexadiene, and many others. Carbon monoxide, aldehydes, and ketones are reduced, although less readily than alkenes; benzene rings and nitrile groups are not reduced. Although hydrogen production (without added alkene) is greater over platinum and rhodium than palladium, the yield of hydrogenated product is larger over palladium. Possible mechanisms will be discussed.

THE DISSOCIATION CONSTANT(S) FOR 2,2-PYRIDYL THIOPHENE

W. F. Arendale and Philip Franklin, Department of Chemistry, The University of Alabama in Huntsville, Huntsville, Alabama 35899

The physical and chemical properties of compounds containing pyridine connected to a second heterocyclic moiety in a 2,2-configuration are being evaluated. The pKa for 2,2-pyridyl thiophene evaluated on a Cary 14 at 330 nm was 5.5 in agreement with the published value.
Instruments that include microcomputer(s) and A/D and D/A converters are also of interest in our laboratory. The pKa of 2,2-pyridyl thiophene was determined with this new type of instrumentation. The pKa for this compound is not 5.5. This paper presents a progress report of our work to determine the best pK(s) for this compound.

Abstracts

REACTIONS OF THE OCTAMETHYLOIMOLYBDATE(II) ION

Thomas R. Webb, and Austin H. Reid, Jr. Dept. of Chemistry, Auburn Univ., AL 36849.

Reactions of the octamethyldimolybdate ion $Mo_2(CH_3)_8^{4-}$ with some organic compounds are described. The complex rapidly converts acid chlorides, anhydrides, and esters to methyl ketones in nearly quantitative yields; esters also yield alcohols on hydrolytic workup. Chemical evidence supports the production of the octa-alkoxy complexes as intermediates in the ester reactions. The octamethyl complex also methylates aldehydes and ketones, but generally less quantitatively (yields 15-90%) and more slowly. The complex also alkylates some alkyl halides, with a typical reactivity order I > Br > Cl and methyl, benzyl > n-butyl. An S_E2 mechanism is suggested for the reactions.

GEOLOGY

AN EARLY PENNSYLVANIAN "FOSSIL FOREST" IN THE PLATEAU COALFIELD

Robert A. Gastaldo. Department of Geology, Auburn University, Auburn, AL 36849.

Erect in situ bulk replaced casts of arborescent lycopods have intrigued paleobotanists since their initial documentation. Few stands of these trees, though, have been documented in sufficient detail to allow for a better understanding of the ecology of these plants. One such autochthonous stand has been discovered recently in an abandoned, unreclaimed strip mine along Sand Mountain, Blount County (T10S, R2E, Sec. 9 Brooksville 7.5' Quad.). The Lower Pennsylvanian sequence along Sand Mountain has been interpreted to represent lower delta plain and open marine facies. The shale cast 'forest' occurs within the lower delta plain facies in the underclay of the Upper Cliff No. 2 Coal. The monogeneric stand is composed of 42 biotically ordered Stigmaria stumps distributed over an approximate 12,000 m^2 area. Stumps are as close as 1 m or maybe as distant as 6 m. The largest preserved stumps have a basal diameter of 80 cm and each of the four departing stigmarian axes prior to the first bifurcation has a mean diameter of 34 cm. Rhizomes vary from a minimum of 18° to a maximum of 29° angle of penetration into the underclay. Rootlets permeate the underclay. Conclusions drawn from field observations and published occurrences of in situ lycopod stands support the contention that autochthonous carboniferous lycopods represent aquatic or semi-aquatic (swamp) plants. There is no published or observed evidence to support recent reconstructions in which arborescent lycopods are depicted as inhabiting aerially exposed soil horizons.

SEDIMENTARY PETROLOGY OF THE CARBONATE SEQUENCE, LAMBERT MATERIALS QUARRY, TALLADEGA CO., ALABAMA

R. K. Aadland and T. J. Carrington. Dept. of Geology, Auburn University, Auburn, Alabama 36849.

The carbonate sequence consists of continuous rhythmically interbedded dark gray pelloid intraclast (breccia clast) lime grainstone beds and light gray sucrose dolomite beds. The dolomite beds were probably an original lime mud that was later completely dolomitized. In gradational beds composed of interlaminated limestone and dolomite, the coloring of the alternating light and dark laminae depends on the concentration of the dark gray (calcite) pelloids and intraclasts "floating" in the surrounding light gray dolomitized "mud" matrix. The lime muds were preferentially dolomitized throughout the section. The dolomite bed that forms the base of the measured section is broken up into a series of lithified, angular blocks that slumped towards the south. The overlying sediments thin and are deformed over the upturned edges of the blocks. Here lithification and probably dolomitization of the slump blocks occurred immediately prior to deposition of the overlying sediments, whereas movement of the blocks occurred during and shortly after deposition of the overlying sediments. The "Dorag" dolomitization model is invoked to explain the rapid dolomitization of the sequence as well as the rhythmic alternation of the dark lime grainstones and light dolomitized mudstones. The type and arrangement of the internal sedimentary features observed throughout the carbonate sequence suggests deposition by waning currents typically observed within individual turbidite beds deposited in a distal basinal setting.

PETROLOGY AND GEOCHEMISTRY OF GRANITOIDS NEAR ROCKFORD, COOSA COUNTY, ALABAMA

George D. Wade, Dept. of Geology, Univ. of Ala., University, AL 35486

Petrographic analysis of granitoid rocks collected near Rockford, Coosa County, Alabama reveals a phaneritic unfoliated equigranular two-mica granite with subhedral to anhedral crystals of plagioclase feldspar, potassium feldspar, quartz, biotite, and muscovite approximately 1-4 mm in diameter. Thin section studies indicate the following modal abundances: plagioclase (An 15-20) 20-25%; K-feldspar 20-25%; quartz 20-25%; biotite 10-15%; muscovite 10%; apatite, epidote, ilmenite and magnetite less than 1% each. Some degree of cataclasis is seen and biotite and muscovite crystals are interlocking.

X-ray fluorescence analysis of powdered and pelletized samples was used to determine oxide concentrations of the collected granites. Analysis revealed the following concentration ranges: SiO_2 70.82 - 72.06%; Al_2O_3 14.99 - 15.43%; Fe_2O_3 3.87 - 3.25%; MgO 0.78 - 0.57%; CaO 2.14 - 1.56%; Na_2O 3.90 - 3.91%; K_2O 4.56 - 4.58%

Variations in chemistry can be related to modal abundances of feldspar, quartz, and biotite.

STRUCTURAL GEOLOGY OF THE WEISNER MOUNTAIN AREA, CHEROKEE COUNTY, ALABAMA

Reginald R. Muskett and Denny N. Bearce. Dept. of Geology, University of Alabama in Birmingham, Birmingham, AL 35294

The Weisner Mountain area is located in the northeast part of the Coosa deformed belt in Alabama. Weisner Mountain, a northeast trending ridge ranging in elevation to almost 1900 feet and having relief of about 1200 feet, and nearby smaller mountains display outcrops of conglomeratic orthoquartzite of the Lower Cambrian Weisner Formation. Surrounding lowlands are underlain by clastic and carbonate rocks of the Middle Cambrian Conasauga Formation and by chert and dolostone of the Upper Cambrian to Lower Ordovician Knox Group.

Weisner strata on the northwest side and at either end of Weisner Mountain are thrust faulted northwestward onto the Conasauga Formation. On the southeast side, float blocks of Copper Ridge (knox Group) chert occur up to the 1000 foot contour for much of the mountain's length. Exposures of chert and dolostone elsewhere southeast of Weisner Mountain indicate that in this area the Knox is in stratigraphic contact with the Conasauga Formation. Therefore Weisner Mountain and similar smaller hills of Weisner quartzite in the area are interpreted as klippen.

Knox and Conasauga strata in the Weisner Mountain area have been deformed into at least two fold-sets. One fold-set striking northeast varies from broad open warps to tight (possibly locally isoclinal) asymmetrical to overturned folds with wavelengths up to 1 km. Northwest trending cross folds of wavelengths to greater than 1 km locally deflect the northeast trending folds.

COMPARISON OF MAJOR ELEMENT CHEMISTRY OF THE
CHATTANOOGA SHALE FROM MACON COUNTY, TENNESSEE
AND TUSCALOOSA COUNTY, ALABAMA

Marvin B. Dismukes, John W. Laird, Steven I. Usdansky, Dept. of Geology, Univ. of Ala., University, AL 35486

Few studies have been done on the variations in major element chemistry of shales, and little is known about the value of such studies in hydrocarbon (and mineral) exploration. In order to examine some of the variations in shale chemistry, samples of Chattanooga Shale from Macon County, Tennessee, and Tuscaloosa County, Alabama were analyzed for their major element constituents using X-ray fluorescence spectrometry. The samples from Macon County are clearly very different from the Tuscaloosa County samples; they contain one-half to two-thirds as much silica (42% vs. 70%), and up to twice as much iron (9% vs. 4%) and magnesium (2.5% vs. 1.5%) as do samples from Tuscaloosa County. Based on the major element chemistries, it appears that the Alabama samples are quartzo-feldspathic arenites whereas the Tennessee samples are organic-rich claystones with little quartz. Clearly this study is but one of many preliminary steps which must be taken to determine the utility of variations in the major element chemistry of shales in resource exploration.

HEAVY METAL DISCHARGE AND FAUNAL CONTAMINATION IN MOBILE BAY, ALABAMA

W. C. Isphording, R. E. Helton, Jr.*, and G. Blount*. Department of Geology-Geography, University of South Alabama, Mobile, AL 36688.

Mobile Bay is the largest single estuary in the central Gulf Coast and serves as the terminus for the Nation's sixth largest river system. As such, it has acted as the depositional basin for rivers draining a 43,000 square mile area, which includes two-thirds of the State of Alabama and portions of Mississippi, Tennessee and Georgia, as well. Extensive industrial and municipal development in the region has, unfortunately, been accompanied by the discharge of large quantities of production effluent into the river system with the consequence that the bottom sediments of Mobile Bay have become contaminated with a variety of heavy metal species. These metals have become adsorbed in the clays: (1) in pore waters, (2) as exchangeable ions in the smectite and illite species, (3) as reducible phases associated with manganese and iron compounds disseminated among the clays, (4) as metals incorporated in organic and organo-metallically chelated compounds, and (5) as structural ions held in the octahedral and tetrahedral sites in the mineral lattices. Because of this manner of partitioning, a significant portion of each metal is thus held in forms that will allow its re-suspension back into the water column or will allow the metal to become "transferred" to marine life by metabolic processes. Work carried out to date has confirmed that elevated quantities of a number of metals are found in the bay's oyster population and no practical means apparently exists to remedy this situation (Sponsored by Mississippi-Alabama SEA GRANT Consortium).

PRELIMINARY RESULTS OF A STRUCTURAL STUDY OF A CARBONATE SEQUENCE IN LAMBERT MATERIALS QUARRY, CHILDERSBURG, TALLADEGA COUNTY, ALABAMA

Victor L. Weeks and T. J. Carrington. Dept. of Geology, Auburn Univ., Auburn, AL 36849.

A preliminary structural analysis was performed on a sequence of highly folded carbonate rocks of the Lambert Materials Company quarry, Childersburg, Talladega County, Alabama. The analysis involved plotting 116 perpendicular poles to bedding planes on an equal area net. The results show a predominant bedding attitude of N22°W; 66°NE and one of less prominence of N31°W; 30°SW. The hinge line, as defined by the two unequally represented fold limbs, plunges S24°E at 6°. Based on the analysis, the limestones were projected to extend to the northwest beneath part of the allochthonous sheet defined by the Kahatchee Mountain fault, to reappear toward Harpersville, Alabama. When checked, we found the same lithologies cropping out in fields west of U. S. Highway 280, eight to ten miles northwest of the quarry site, and beyond the Kahatchee Mountain fault, as predicted. Our lithologic and structural trends therefore project at a high angle to those mapped by previous workers, and beneath part of the allochthonous block defined by the Kahatchee Mountain fault.

Abstracts

PALEONTOLOGY OF A MIDDLE ORDOVICIAN BIOHERM
IN THE CHICKAMAUGA LIMESTONE
AT THE RED MOUNTAIN EXPRESSWAY CUT, BIRMINGHAM

Carl W. Stock, and D. Joe Benson, Department of Geology, The University
of Alabama, University, Alabama 35486.

  Bioherms are common in the Chickamauga Limestone (Middle Ordovician) of
the Valley and Ridge Province in the Birmingham, Alabama area. Excellent
exposures of at least six bioherms are located in the Red Mountain
Expressway cut in Birmingham. The largest bioherm (5.3 m high by 6.1 m
wide) located at road level, was studied in detail. Over 2300 fossils in
the bioherm have been counted and identified, using metric grid counts.
The assemblage is dominated by ramose, nodular, encrusting, and bifoliate
bryozoans, and ramose calathid dasyclad algae. Typically compressed
brachiopods and hemispherical demosponges are common, with lesser numbers
of solenoporid algae, pelmatozoan echinoderms, laminar stromatoporoids and
tabulate corals, non-calathid dasyclad algae, gastropods, ostracodes,
trilobites, and orthocone cephalopods. Bryozoans are distributed uniform-
ly within the bioherm. Calathid algae and brachiopods increase upward,
while demosponges decrease upward. Fossil content of the flank beds is
similar to that of the bioherm, although echinoderm and brachiopod debris
are more common, and stromatoporoids and tabulate corals are absent.
Other, smaller bioherms at the Expressway do not differ significantly in
fossil content. This fossil assemblage is quite similar to the coloniza-
tion stage of bioherms in the Carters Formation of south-central Tennessee.

THE NATURE OF THE BASEMENT-TUSCALOOSA (CRETACEOUS) UNCONFORMITY
IN THE AUBURN AREA, LEE COUNTY, ALABAMA

Thomas J. Carrington. Dept. of Geology, Auburn Univ., Auburn, AL 36849.

   Exposures of the unconformity separating the subjacent metamorphic
rocks from the suprajacent Tuscaloosa Formation (Cretaceous) sands and
gravels range in elevation from about 390 to 730 feet in the Auburn, Lee
County, Alabama area. The general strike of the highly folded
metamorphic rocks is about N 55-65° E, and prominent ridges are upheld
by quartzites, whereas lower areas are underlain by schists and/or
dolomitic marble. All lithologies are part of the Pine Mountain Group.
Every ridge thus far checked in the Auburn 7-1/2" topographic quadrangle
has residual rounded pebbles and/or cobbles on crestal areas, strongly
suggesting that all the ridges were once covered by Tuscaloosa sands and
gravels. Presumably, base-level was raised as a marine shoreline
advanced from the south to a line about 15 miles south of Auburn, and
streams filled the existing valleys and finally spread a blanket of
fluvial materials across the entire area, burying even the highest
ridges. Progressive exhumation of the old topography occurred as a
result of regression of the shoreline, lowered base-level and rejuvena-
tion of the streams in the area. Most of the previously-deposited
Tuscaloosa was removed. In general, it is believed that the present
topography of the area is similar to that which existed just prior to
Tuscaloosa time, with minor modifications.

ELEMENTAL VARIATIONS IN THE AMERICAN COAL BED, BLACK WARRIOR BASIN, ALABAMA

George E. Springston, Dept. of Geology, Univ. of Ala., University, AL 35486

Variations in the relative abundances of Si, Ti, Fe, S, Ca, K, Zn and P were studied in 21 samples of the American coal bed of the Pennsylvanian Pottsville Formation at four localities northwest of Birmingham, Alabama using X-ray fluorescence spectrometry. The values listed below are the ranges of sample peak heights divided by monitor peak heights, the monitor being one of a set of seven samples collected near Graysville, Alabama: Si = 0.52 - 3.53; Ti = 0.34 - 1.92; Fe = 0.52 - 2.89; Ca = 0.22 - 1.37; K = 0.32 - 3.76; S = 0.66 - 2.19; P = 0.04 - 1.01; Zn = 0.57 - 0.88. Standards were prepared that allowed determination of the weight percentages of Si and Ca. For samples containing detectable amounts of these elements, averages of 1.5% Si and 0.2% Ca were found.

The variations seen are a result of variations in the mineral content of the coal. Fe and S show a strong covariance and are probably present as iron sulfides such as pyrite. Weathering has led to two distinct patterns of elemental abundances: Fe, S, and Ca are covariant and Si, Ti, and K are also covariant, but in a pattern opposite to the first. There do not appear to be any other patterns to these variations, either in single outcrops or throughout the study area.

GRCHEM: GRANITE CHEMISTRY FROM MODAL MINERALOGY

Steven I. Usdansky, Dept. of Geology, Univ. of Ala., University, AL 35486

Although students in igneous and metamorphic petrology classes are often asked to determine modal abundances of minerals in the rocks they are studying, little effort is generally put forth to relate the mode to the actual whole-rock chemistry. With the widespread availability of computers for instructional purposes, it is now possible to change this situation. GRCHEM is a computer algorithm written in BASIC which calculates chemical analyses of felsic plutonic rocks given their modes. Input to GRCHEM consists of modal abundances of quartz, feldspar, mica, epidote, hornblende, and garnet, the An content of the plagioclase, the Or content of the alkali feldspar, and the bulk $Fe/(Fe+Mg)$ value. Once a bulk chemical anlysis is obtained for a rock, options in GRCHEM permit alteration of any of the above compositional parameters as well as modal abundances of any of the phases so that the effects of these changes may be readily observed. Tests on rocks for which both modal and chemical analyses are available show that the chemical analyses predicted by GRCHEM are in excellent agreement with actual analyses despite the gross simplifications in phase chemistries. Through the use of instructional computer programs such as GRCHEM, petrology students can gain a much more thorough understanding of the relationships between the modal mineralogy and the chemistry of a rock.

FORESTRY, GEOGRAPHY, CONSERVATION, AND PLANNING

RETURNING SURFACE MINED LAND TO ITS ORIGINAL CONTOUR

Wilbur B. DeVall, President, Proxy Services, Auburn, AL   36830

Coal surface mined lands in Alabama must be reclaimed under the con-
ditions set forth in Act No. 81-435. Reclamation must be done so as to
protect the taxable value of property and preserve natural resources
within the State. It must also protect and promote the health and
safety of the people of the State. Variation in terrain, climate, bi-
ologic, hydrologic, geologic, vegetative, chemical, and other physical
conditions make the reclamation process challenging. One challenge is
the provision that land shall be returned to its "approximate original
contour." By definition this means that surface configuration must be
achieved by filling and grading the mined area so that when reclaimed
the general surface configuration of the land approximates the land pro-
file prior to mining. The reclamation process involves revegetation
with plants or growth which replace, where required, original ground
cover following ground disturbance. Prior to mining a reclamation plan
must be filed with the State's regulatory agency. It must assure that
the productivity of the land will be equal to the productivity of the
land prior to mining, or better. Environmental protection performance
standards set forth in the law require not only that the condition of
the land be capable of supporting uses which it was capable of support-
ing prior to mining but that it be stabilized and compacted with re-
gard to all backfill and that it be graded in order to restore the
approximate original contour. This means removal of all highwalls,
spoil piles, and depressions unless the latter be required to impound
surface water and prevent runoff.

AN ANALYSIS OF THE MULTIFARIOUS STRESS FACTORS UPON THE ECOSYSTEM OF THE FLORIDA EVERGLADES

Thomas J. Kallsen. Department of Geography, University of Alabama,
University, AL 35486

The Florida Everglades ecosystem is currently under increasing
stress due to human intervention. The critical factor is water, an
environment adapted to a natural wet and dry cycle has been altered
by urbanization, canalization and drainage of wetlands. This has
had major ramifications upon the wildlife and plant life of the re-
gion. An area by area study of the problem is presented.

Abstracts

EXPANSION OF URBAN PLANNING PRACTICE:
THE ALABAMA MAIN STREET EXPERIENCE

Darrell C. Meyer, AICP. Graduate Program in Planning, Auburn
University, Auburn, AL 36849.

Urban planning practice is ideally based on use of the "planning
process." Rational, comprehensive and complete--the use of this
process is said to bring ordered growth and development to cities
that know only strip commercial development and sprawl. To be effec-
tive, the planning process should be used in its complete form. All
the components should be in place: policy, planning and management.
Unfortunately, there are many municipalities in Alabama where this
process has been misused, and local development patterns and lack of
economic success downtown provide ample evidence of the obvious.
The Alabama Main Street Program builds upon the comprehensive
planning process; it replaces many of the elements forgotten by some
planners and communities. Rather than dwelling on problem-solving,
Main Street communities are looking at ways to avoid problems. The
program provides a way to improve the physical and economic image
of downtown through improvements in organization, promotion, design,
economic restructuring and community connection. While typical urban
planning in Alabama has been mostly concerned with research, analysis,
and proposing action, the Main Street Program in each of the four
pilot communities in Alabama has been concerned also with remaining
on the scene to see things through in the community. This is put-
ting the management component back into planning practice: a most
welcome expansion of urban planning practice in Alabama.

LOCATIONAL ADJUSTMENTS IN THE NINETEENTH CENTURY ENGLISH IRON INDUS-
TRY: A REGIONAL EXAMPLE

David C. Weaver, Department of Geography, The University of Alabama,
University, AL 35486.

The 'Black Country' of England developed from the earliest days
of the industrial revolution as one of the world's major iron and
steel production districts. This paper traces some of the impacts of
technology and resource consumption on the spatial character of The
Black Country iron industry before 1870. The primary focus is on the
Stour Valley section of the Black Country district. The main view-
point expressed is that economic activities, no matter how self con-
tained they may be, are part of a larger economic system comprised not
only of some points in space but also of a particular segment of time.
Data are presented to show dramatic shifts in plant location between
the eighteenth and nineteenth centuries, as ironmasters responded to
technological advances which generated increasing levels of coal
consumption.

WIND FLUCTUATIONS IN TIME INTERVALS OF SECONDS

Oskar M. Essenwanger, Army Missile Command, Redstone Arsenal, AL 35898

In the boundary layer wind fluctuations of short time intervals in the magnitude of seconds are commonly interpreted in terms of turbulence theory. According to Kolmogorov, Obukhov and Corrsin, this requires a -5/3 slope in a diagram of the power spectrum versus the (inverse) wave length in double logarithmic coordinates for the inertial subrange of turbulence. The spectra of wind measurements (Gill u-v-w anemometer) at Huntsville, Ala., at one-second intervals, show, however, a different slope in the wave length region where one should expect agreement with turbulence theory. Interpretation was attempted by modelling power spectra in terms of white or red (exponential) noise, which is a random process without or with persistence, respectively. It is apparent that for red noise data the slope of the power spectrum lines versus the inverse wave length in double logarithmic coordinates depends on the first lag correlation (Markov chain), and white noise is the special case for the lag correlation zero and slope zero. Further, one of the red noise conditions with first lag correlation of about 0.9 produces a slope of -5/3. The investigations lead to the conclusion that some of the spectra follow the models of red noise. Although some authors assume exponential red noise in the autocorrelogram of the wind even for turbulence, other turbulence parameters such as surface roughness, stability, or the intensity of turbulence need to be added for an unambiguous identification of turbulence.

PERU: LAND OF CONTRASTS

William Reese Strong, Dept. of Geography, Univ, of North Alabama, Florence, AL 35632

Even though Spanish is the lingua franca of Peru, more people speak the Pre-Colombian language Quechua. Modern industrial establishments coexist with traditional craft occupations. Pizza parlors and Kentucky Fried Chicken establishments vie with street vendors for hungry palates Internationally conceived designer jeans and leg warmers appear on the streets of Lima while traditional llama and alpaca woolens are seen more often in the hinterlands. Cracked and crumbling edifices of the Spanish conquest period lie on Pre-Colombian megalithic structures which have withstood the ravages of time. From the Pacific to the Amazon, the enigmatic coastal desert gives way to mountain tundra and ultimately to tropical selva. Peru is indeed a land of contrasts and offers the geographer a virtual regional laboratory for the exploration of both physical and human geographical problems. This paper offers suggestions for geographical research and teaching by reviewing selected cultural and physical characteristics within this South American country.

Abstracts

ESTIMATING ADVERSE IMPACTS FROM FARMLAND CONVERSION

H. A. Henderson and Peter Scheffler

Increasing concerns are being expressed about the conversion of farm-
land to other uses and the resulting loss in food capacity. In an
effort to improve quantification of the impacts, the authors have
developed a means of estimating the adverse impact on agriculture of
converting specific proposed sites.

The measure is in two major categories reflecting (1) the potential
farm income of the specific site, and (2) eventual secondary impacts in
the general area. Site factors consider the amount of land in different
Important Farmland categories and potential sustained net farm income.
Secondary impacts include estimates of five factors: agricultural
suitability of the general area, size of the area placed at risk of
later conversion, commitment of the area to agriculture, commitment of
local people to conservation, and community character. All of the
factors are quantified and combined to provide a means of ranking the
sites in terms of likely total adverse impacts on agriculture from
their conversion.

The measure provides an improved preliminary guide for program and
project managers to select sites which minimize adverse impacts of
development projects. It can be assembled with a minimum of cost using
readily available information. More detailed measures may follow
for complex analyses such as those that require an environmental impact
statement. They will likely include similar factors.

NEANDERTHAL MAN: CLIMATE AND GEOGRAPHICAL ISOLATION

Mary Katherine McInnish and Andrea Priscilla Holland, Dept. of
Geography, University of North Alabama, Florence, AL 35630.

Climatic upheaval and geographic isolation influenced the
evolution and development of the "Classic" Neanderthal, Homo sapiens
neanderthalensis, in western Europe. During the Wurm I glacial
period of the Pleistocene, conditions in that area permitted
biological and cultural adaptations of the indigenous population
which resulted in a specialized form of man, a geographical varient.
Neanderthal man, in western Europe, became superbly adapted to his
environment. He survived under harsh, exacting circumstances. He
evolved and endured over many millennia before he became extinct.
About thirty-five thousand years ago Neanderthal man disappeared.

Neanderthal man underwent hardships and difficulties. In over-
coming those problems he made available, for settlement, regions
heretofore closed to man; and with Neanderthal man, came the first
glimpse of a religious, moral, and social consciousness. This paper
traces some of the diverse factors which interacted to bring into
existence that geographically distinct population of western Europe,
the "Classic" Neanderthals.

A PRACTICAL SOLUTION TO THE SOIL EROSION PROBLEMS IN
LAUDERDALE COUNTY, ALABAMA

Russell W. Harper, Soil Conservation Service and
Steven R. Sax, Tennessee Valley Authority

This report addresses the most basic concept of land, its protection. Most land is covered with a few inches of soil that will support all the vegetation growth in the world. Soil replaces itself at a slow rate, yet, soil erosion losses of 10-20 tons per acre per year are not uncommon in Alabama. Cropland represents the largest area of soil erosion in Alabama, however, any exposed soil to rain, strong winds, or mechanical disturbances will be good candidates for erosion. These areas include strip mined lands, construction sites, unpaved roadways, and embankments.

The logical way to control erosion would be to maintain a cover of vegetation or crop residue. The cover could come in the form of double cropping, winter cover crops, or a grass base rotation. The greatest potential for reducing erosion would be to change farming practices. Conservation tillage or no-till is gaining greater acceptance because it is economical, controls erosion, saves fuel, and saves time.

METHODS TO CAUSE PRIVATE FOREST LANDOWNERS
TO PRACTICE MULTIPLE-USE FOREST MANAGEMENT

Tommy Patterson, Alabama Forestry Commission, Montgomery, AL 36130

Forestland is being diverted to other uses at an increasing rate while the demand for wood products, water, recreation, and wildlife is rapidly rising.

Since private non-industrial landowners control 70-80% of the southern forestland, this sector offers the best opportunity to significantly increase the output of all forest resources through multiple-use forest management.

The challenge is to develop and promote incentives for private forest landowners, on a voluntary basis, to provide an adequate timber supply and at the same time meet the expected demand for recreation, wildlife habitat and water resources while maintaining the environmental amenities associated with the forest resources.

A survey has been made of leaders and experts in the multiple-use forest management field asking for their suggestions to promote this concept of forest management. These consolidated suggestions will be presented to the Southern Group of State Foresters in an effort to have them implemented.

TEMPERATURE TRENDS IN NORTH ALABAMA
CORRELATED WITH UPPER AIRFLOW PATTERNS

Frank N. Himmler, Department of Geography, University of North
Alabama, Florence, Alabama 35632-0001

Interest in the relationship between the airflow of the upper
troposphere and surface weather phenomena has held the interest of
climatologist since the discovery of the jet-streams in the 1940's.
This relationship has been documented in a number of research
studies. This paper endeavors to search for specific relationships
between surface temperatures and the height of the 500 mb. surface
and the wind direction and speed at the 500 mb. level. Surface data
represents Muscle Shoals, Alabama and upper air data comes from
Nashville, Tennessee, the nearest station for that type of
observation. Statistical analyses reveal positive correlations
between surface temperatures and increasing heights of the 500 mb.
surface. Correlations ranged from .578 to .887. No correlations,
either positive or negative, were discernable when surface temperatures
were compared with wind direction and wind speed at the 500 mb.
level. Data for the study was from the period 1957 to 1972. Only
winter months (December, January and February) and summer months
(June, July and August) were analyzed.

ATTITUDES OF ALABAMA RESIDENTS TOWARD FORESTRY

Douglas A. Smith and Carl V. Bylin

In 1980, the Alabama Forestry Commission and the
Alabama Forestry Association instituted a study to
determine the attitudes of Alabama residents towards
forestry. The Commission's main interest was to
determine how it might better serve the needs of the
taxpayers of Alabama. The Alabama Forestry Association,
which partially funded the study, had different
objectives which are not dealt with in the paper.

A questionnaire was developed and a telephone
survey was instituted. In addition to demographic
information, the survey questions concerned wildfire,
forest industry, timber supply, forestland ownership
and government assistance.

Results provided an insight into how the Alabama
public views aspects of the forest resource. These
results enable the Alabama Forestry Commission to better
direct its programs.

PHYSICS AND MATHEMATICS

DIGITAL IMAGE PROCESSING OF GALAXIES AND QUASARS

Jack W. Sulentic. Dept. of Physics and Astronomy, Univ. of Ala.,
University, AL 35486

Spatial frequency filtering techniques have become important tools
for analysing and processing astronomical data. We discuss here both
applications to the analysis of galaxy structure from direct photo-
graphs and the processing of digital CCD spectra. Median filters with
varying spatial frequency sensitivities have been applied to photo-
graphs of the galaxy NGC4319 and nearly quasar. The plates were taken
at the prime foci of the Kitt Peak 4 meter and Palomar 5 meter reflec-
tors. The digitized photographs were played back subsequent to filter-
ing, in order to visually search for evidence of high frequency struc-
ture in the images. A narrow luminous connection was found extending
from the quasar to near the nucleus of NGC4319. This represents the
most conclusive evidence to date for a physical link between discor-
dant redshift objects. Low frequency median filters have been employed
to optimize the background subtraction from digital spectra of the
binary galaxy K427AB and related supernova. Spectra were obtained with
the new double CCD spectrograph which utilizes a dichroic beam splitter
to produce simultaneous red (5000–10000Å) and blue (3000–5000Å) spectra.
The median filter technique has already produced a distinct improve-
ment in S/N relative to traditional sky subtraction techniques. This
improvement has revealed Hα emission line structure between the dis-
cordant redshift galaxies not previously suspected. Partial support
from the Research Grants Committee of the U of Ala. is gratefully
acknowledged.

MEASUREMENTS OF ELECTRON ENERGY DISTRIBUTION FUNCTIONS IN A PLASMA

M. D. Haworth and R. E. Kribel. Dept. of Physics, Auburn University, AL
36849

The design of a planar, multi-gridded electrostatic energy analyzer to
measure the electron distribution function in a plasma is discussed.   The
nature and solution of potential problems such as space charge effects,
finite size effects, and electric field penetration are also included.
Finally, experimental analyzer measurements performed on the Auburn DC
Multidipole Plasma Device are presented.

Abstracts

LOSSY TRANSMISSION LINE ANALYSIS OF SEMICONDUCTOR PACKAGES

S. Chao and D. L. Shealy. Dept. of Physics, University of Alabama in Birmingham.

As devices become faster and more complex, it has become apparent that the VLSI package design can limit system performance as a result of high speed switching noise. In order to more accurately describe the electrical interactions, a lossy transmission line model has been developed for the package lead runs interacting with emitter coupled logic devices as well as other lossy transmission lines representing the PC board and other packages. A numerical inverse Laplace transform algorithm has been formulated for solving the lossy transmission line partial differential equations with suitable boundary for simulating the electrical performance and interactions of a two transmission line system representing a VLSI package and a PC board. The electrical inputs to the system can be a ramp step or a series of ramp pulse voltage functions with finite rise times, which are used to model the digital signals of a VLSI device. In a previous study[1], time-domain reflectometry and sampling techniques have been used to measure the voltage response of test transmission lines in order to validate the computer simulation results.

In this study, a loss transmission line analysis is carried out for several VLSI packages and PC board configurations in which the device rise time, load capacitance, and the relative package – PC board characteristic impedance are varied. The maximum overshoot voltage at the load and outside the package and the half-life decay time of the package noise will be examined as a function of design parameters. Using time-domain reflectometry and sampling techniques, the load and package voltage response of the VLSI packages can be measured and compared to the modelling results.

[1]D.J. Reed, D.L. Shealy, "A Transmission Line Model of a VLSI Package," February, 1983, Solid State Technology

PROGRAMMING THE APPLE COMPUTER FOR ANALOG-TO-DIGITAL CONVERSION

Daniel Katz and Chester Alexander, Jr., Dept. of Physics and Astronomy, University of Alabama, University, AL 35486

An Apple II computer has been programmed to facilitate analog to digital conversion with the Mountain Hardware A/D, D/A interface board. A program was written in Applesoft to call any of five other programs written in machine language. The user can choose the time used to take each data point, and the total total time of data accumulation. A minimum of two or a maximum of 256 readings is averaged for each data point. After data accumulation, the data is plotted on the computer screen. The software and hardware will be explained and demonstrated.

DIFFUSION IN DISORDERED SYSTEMS

P. B. Visscher, University of Alabama

Theoretical calculations of conductivity or diffusivity in solids usually assume the material to be perfectly ordered. All real solids, of course, have some degree of disorder due to impurities or lattice defects. In three-dimensional systems this does not qualitatively change the behavior, in that disordered systems still obey Ohm's law (for conductivity) or Fick's law (for diffusion). However, there are many systems of practical interest which are quasi-one-dimensional (e.g. polyacetylene) or quasi-two-dimensional (e.g. intercalated graphite) because the current-carrying particles are confined to a linear chain or to a lattice plane. In these low-dimensionality systems it turns out that the disorder changes the behavior qualitatively. The frequency-dependent conductivity, for example, has a square-root cusp at zero frequency in a one-dimensional system:

$$\sigma(\omega) = \sigma_0 + C \, \omega^{1/2} + O(\omega)$$

This behavior can be analysed using a scale-coarsening technique, which will be described; it is related to the renormalization-group methods used in the theory of critical phenomena. We have shown using this approach that the square-root frequency dependence is universal to all weakly disordered one-dimensional systems, and have obtained the corresponding result in two dimensions, which was not previously known: in two dimensions the conductivity has a logarithmic term.

ESR STUDIES OF A
SINGLE CRYSTAL OF X-IRRADIATED 3-HYDROXYGUANINE

A.N.M.S. Shahidain and Chester Alexander, Jr., Dept. of Physics and Astronomy, University of Alabama, University, AL   35486

A single crystal of the oncogen 3-hydroxyguanine has been prepared and irradiated with x-rays at 77 K. ESR spectra have been recorded at 300 K for rotations of the crystal about the a, b and c' crystal axes. Nuclear hyperfine- and g-tensors have been determined, and these data indicate that a hydrogen atom has been abstracted from the N_3 position. This damage produces a nitroxide radical species with coupling to nitrogen and oxygen atoms.

Abstracts

COMPUTER SIMULATIONS OF SPURS IN SPIRAL GALAXIES
Gene G. Byrd, Dept. of Physics and Astronomy, University of Alabama
University, AL 35486

Spiral galaxies show a variety of arm patterns in their disks. Some
have two main arms spiraling outward from the nucleous. Others have a
more chaotic pattern of many shorter arms. Galaxies that have two main
arms can also have shorter armlets or spurs. The two-armed patterns
are generally thought to be a gravitationally induced density wave
traveling around the nucleous. One mechanism that has been suggested
for the short spurs in both two-armed and chaotic disk galaxies is
that they are localized gravitational disturbances caused by orbiting
complexes of gas and stars in the disk. The disturbance feeds on itself
increasing the strength of the disturbance greatly over that caused by
the complex alone. Previous computer simulations of this process con-
sidered the disturbance to be localized in an area around the disturb-
ing complex which was <u>small</u> compared to the distance to the center of
the galaxy. The results of the simulations show the disturbance was
large in size and the "local" assumption not true. New simulations
are presented here in which the local assumption is not made. Disturb-
ing gas complex masses comparable to those seen in nearby galaxies are
assumed. The resulting disturbances are found to be as strong as in
the previous model and to evolve from the simple spur shape found
before to a complex shape covering much of the galaxy disk. This work
was partially supported by a NASA-ASEE Summer Faculty Fellowship at
Stanford University and NASA-Ames Research Center.

NEW DEVELOPMENTS IN OPTICAL ABERRATION THEORY

A. Kassim and D.L. Shealy. Dept. of Physics, University of Alabama in
Birmingham.

The general concept of aberrations in an optical system is associated
with the failure of the system to form point images for each object
point. The deviation of the image space wavefront from a reference
spherical wavefront is defined as the wavefront aberration and can be
related to the transverse aberration, which specifies the distance on
the image plane from the ideal image point (center of reference
spherical wavefront). In this work, caustic surface theory (APPLIED
OPTICS, 21 3299, 1981) has been used to express the wavefront aberration
and the transverse aberration in closed form. The results have been
compared to conventional aberration theory and ray tracing for
reflection from a spherical mirror and from a Wolter type I x-ray
telescope.

INDUSTRY AND ECONOMICS

MAJOR SMALL BUSINESS MISTAKES IN A RECESSION ENVIRONMENT

Leon L. Smith, Dept. of Marketing and Management, Univ. of North Alabama, Florence, AL 35632

During 1981 and 1982, the Shoals, Alabama marketing area experienced an especially severe recession. This environment resulted in several adverse reactions among small businesses of many types. These "mistakes" appeared with such frequency across a wide spectrum of business activity, it became evident that a recession environment could, and did, trigger predictable management behavior. Four areas predominated: business policy, control systems, marketing strategy and business image. Business policy mistakes included lack of concentration on basic expertise, cessation of professional assistance, reluctance to discuss problems with creditors, and failure to cut variable costs. Control systems mistakes included non-establishment of cost or profit centers, unjustified credit practices, unawareness of inventory costs, and miscalculation of interest expense. Marketing strategy mistakes included misunderstanding of customer service requirements, reduction of promotion expenditures, failure to retarget market, and misapplied pricing strategy. Business image mistakes included ignorance of the basic business being transacted (product versus service), abandonment of profitable market segments, failure to provide post-purchase reinforcement, and abandonment of the small business service ideal. Using a sample of fifty-four diverse business activities and four banking institutions, this review has prompted broad-based conjectures for future avoidance of recession-induced reactions. These include computer-based control systems with banking interface and establishment of fundamental business policies with professional assistance.

MINI AND MICRO COMPUTER SOFTWARE IN INDUSTRIAL APPLICATIONS

Rishi Raj Chowdhury, Systems Analyst, Stockham Valves & Fittings, Inc. Birmingham, Alabama 35212

The 80's can be classified as the decade of mini and micro computers. In this paper, an analysis is shown to depict the necessity of software packages. The Industrial Applications are detailed out. Based on particular application and the computer hardware, software packages must be considered. User involvement, software vendor support, cost of the software and reliability are important factors to be considered besides just good features of a software package. Some of the leaders of software packages are also discussed.

PERSONAL COMPUTERS IN BUSINESS

Willhardt, John A., and Jim Chen, Dept of CIS, College of Business
Administration, Alabama State University, Montgomery, AL 36195.

In 1982, more than one million microcomputers were brought into
offices. With suitable software and configuration, the microcomputer
is capable of handling many business tasks such as word processing,
list processing, accounting, budgeting, cash-flow analysis, and capital
investment analysis. A host of pre-programmed packages are available
to meet the various needs. There are 3 ways to acquire hardware: rent,
purchase, and lease with an option to buy. Rent is a current expense.
Purchased hardware can be treated in 2 ways: taking a 10% investment
tax credit and depreciating the cost over 5 years, or expending up to
$5,000 and taking the tax credit and the depreciation against the
balance. Lease payments may be either expended or capitalized. Capi-
talization brings the lessee the tax credit at the expense of higher
lease payments. There are also 3 ways to acquire software: purchase,
rent, and self-development. If the software and the hardware are
purchased at a single lump-sum price, the software cost can be added to
the hardware cost. The purchase price of software can also be amortizec
over 5 years or less. Rent is a expense. The cost of custom software
can be either expended or amortized. In selecting microcomputers, a
business needs to decide specifically the tasks that are to be accom-
plished with them. Learn as much as possible about personal computing
by talking with vendors and field references. Ensure that software is
available to accomplish the required tasks. Maintanance should be
available and convenient to the firm. Obtain bids with a request for
proposal. When a vendor is selected, request a written contract that
carefully details what is to be provided.

AN ENERGY AUDIT: A CASE STUDY

A. Lee Cobb, Dept. of Management Science & Statistics, Univ. of Ala.,
University, AL 35486

An energy audit for a residence includes such information as
weatherstripping, caulking, insulation, glass area, direction of each
opening, ceiling heights, and floor space. Once this information is
collected, it is fed into a computer and the end results are recommen-
dations for change, estimated costs and payout times, and estimated
energy bill. The difficulties encountered by an energy auditor in the
case examined were that the house is a flat-top (no attic), built on
a slab (no access beneath), and the rooms in general were not square
or rectangular, but rather most rooms branched off of the central
living room at odd angles. The result was the audit took over eight
hours and many crude estimates. The only economically feasible
recommendations were improved weatherstripping and replacing some
worn caulking.

Abstracts

DOWNTOWN HUNTSVILLE, AL: PERCEPTIONS OF HUNTSVILLE CITIZENS

Abstracts

DOWNTOWN HUNTSVILLE, AL: PERCEPTIONS OF HUNTSVILLE CITIZENS

Marsha D. Griffin, Department of Management and Marketing, The University of Alabama in Huntsville, Huntsville, AL   35899

To determine how Huntsville citizens feel about the downtown area in general and about shopping opportunities in particular, 690 people were surveyed via an area sampling plan. The findings pertain to the 98 percent of the sample who had been downtown at least once. Sixty-eight percent reported they went downtown at least monthly, and 39 percent indicated a visit at least weekly. The persons who go downtown most frequently are males, persons between 55 and 64 years of age, persons whose highest educational attainment is either grade school or college degree, persons employed parttime outside the home, students, persons with either 3-4 or over 6 in their households, persons whose family income before taxes was over $50,000 in 1981, persons who rely on television for information about local retailers, persons who live within walking distance of the downtown area, and blacks. The four largest "drawing cards" for the downtown area are the courthouse, the civic center, the library, and the shopping facilities. Almost 50 percent rated the shopping facilities as poor, and 51 percent said they had not shopped downtown in over six months. The majority of respondents said they would not shop downtown at night if the stores were open, indicated a lack of transportation was not preventing them from going downtown, but reported they thought parking facilities downtown were inadequate. Eighty-four percent gave the downtown area an overall rating of fair or good on a good-fair-poor scale. Over 80 percent thought the downtown area looked either a lot better or at least somewhat better than it used to.

PROTECTION: IS IT THE ANSWER?

J. E. Weaver. Dept. of Economics, Univ. of North Ala., Florence, AL 35632

The paper considers whether or not protection, higher barriers to international trade, is the correct policy for the United States today. It is held that politics, not economics, determines the goals of a country and that the need for clear, ordered goals is often ignored when economic policy is developed, making policy alternatives difficult to evaluate. Repercussions of a policy need to be considered also. A number of issues surrounding international trade are discussed, including types of trade barriers used, effects of trade barriers, Buy American campaigns and the effect on international trade of floating exchange rates. The paper concludes that protection is not the best policy for the United States. The gains from it would be short term and outweighed by the losses caused by the higher trade barriers.

Abstracts

WELFARE COSTS OF EXCESS HEALTH INSURANCE: A REAPPRAISAL

James R. Seldon, Dept. of Economics, AU Montgomery AL 36193

With health care spending now exceeding one dollar in every ten of U.S. gross national expenditure, and with the prices paid for that care continuing to rise at rates substantially above the overall inflation rate, recent concern has focused on the role of health insurance as a demand side influence in the medical marketplace. Insurance in effect reduces the point-of-service prices paid by consumers of hospital and medical services, thus tending to increase demand and, ceteris paribus, resulting in a combination of higher outputs and higher prices. Insurance is desirable, from both individual and societal perspectives, as a means of reducing (sharing) risk. However, as Martin Feldstein [JPE 81,2(1973)] noted a decade ago, excess insurance will -- particularly if it is subsidized relative to other goods and services through favorable tax treatment of premiums -- generate net welfare costs to society by distorting resource allocation. This paper reexamines Feldstein's analysis, incorporating into it the influence of premiums paid and income foregone as a consequence of private and collective decisions to purchase insurance. In addition, it considers the implications of having reduced risk of health costs as a public good, a condition under which insurance would be undersupplied by the private marketplace in the absence of the additional demand induced by tax subsidization.

ALABAMA'S TAX EFFORT AND SERVICE EFFORT

Raymond M. Johnson, Dept. of Acctg. & Finance, Auburn Univ. at Montgomery, Montgomery, Alabama 36193.

The purpose of this study is to compute a measure of tax effort and a measure of service effort for selected states and local services for the fifty states. These measures are used as a basis for comparing Alabama with other states. The year 1977 is the base year for the interstate comparisons because this is the latest year for which all the data are available. The tax effort index used in this study is based on the economic ability of the states to pay taxes. Alabama is ranked 34th in its ability to pay taxes. The effort expanded by Alabama to raise tax revenue causes it to rank last, along with Arkansas, relative to the other states. Alabama's relative index for providing educational service, highway services, public welfare services, and health and hospital services cause the state to be ranked 37th, 28th, 31st, and 7th, respectively, among the 50 states.

Abstracts

NATURAL MONOPOLIES VERSUS DESIRABLE MONOPOLIES

Z. A. Seldon and J. R. Seldon, Department of Economics, Auburn University at Montgomery. Montgomery, AL 36193

Even with everywhere declining marginal and average costs curves the emergence of a stable single-firm industry equilibrium is not in general guaranteed but will depend upon the reaction functions of rivals. This paper proposes that monopolies be defined as natural when they emerge from market forces; as desirable when a single firm can produce the entire market output at a lower cost than two or more firms; and as obtainable when single-firm production of that output can be achieved with welfare gains. The potential welfare gains from regulating a desirable monopoly ob iously do not equal the dead weight loss associated with monopoly pricing if regulatory costs are non-zero; but in addition it is noted that it is the actual ('natural') market outcome, monopoly or otherwise, that must serve as the starting point for gross welfare gain calculations. Finally, it is observed that regulation constraining firms to practice average cost pricing need not increase welfare even under zero regulatory cost assumptions.

THE ORIGINS OF FIRE INSURANCE IN ANTEBELLUM ALABAMA

Clarence A. Spencer, Jr. Department of Economics, Finance, and Business Law, College of Commerce and Business Administration, University, AL 35486.

The origins and development of the fire insurance industry in antebellum Alabama and the pivotal role played by this industry in the development of the state has received little attention. Background information concerning the early insurance companies chartered in other states which were operating in Alabama during its frontier period is presented. These companies served as a source of information and a training ground for the founders of Alabama's first domestic fire insurance companies. The mercantilistic philosophy which prevailed in the state during this period is indicated and the method by which this philosophy was implemented is discussed. This article points out the decisive role played by this philosophy is fostering the environment which made it possible to found domestic insurance companies that worked cooperatively and constructively in tandem with foreign insurance companies already operating in the state. The article also traces the evolution of firefighting and fire prevention measures and indicates the reciprocal influence exerted between that factor and the emerging fire insurance industry. The factors which lead to the founding of Alabama's first domestic fire insurance companies are traced. In addition, the methods of operation, the style of management, and the degree of successful operation of these companies are presented. In conclusion, the contributions which the fire insurance industry made to the development of antebellum Alabama are discussed.

Abstracts

ECONOMIC KNOWLEDGE AND ATTITUDES TOWARD ECONOMIC ISSUES

James F. Haynes. Dept. of Business Administration, Athens State Col., Athens, AL 35611

Recent problems in the American economy have increased the interest in economic education. More attention has been placed on the need to improve the economic literacy of high school students. New curriculum programs have been created, but little attention has been given to assessing the outcomes of these programs. This study examined the knowledge and attitudinal consequences of the required semester course in economics taken by all twelfth grade students in Alabama. The experimental group contained 105 students at Grissom High School in Huntsville who had taken economics during the fall term of 1981 and the control group contained 101 students who would take economics during the spring term. A posttest-only control-group design was utilized. At the end of the fall term both groups were given the Test of Economic Literacy and the Social Opinion Questionnaire. The TEL measured students' understanding of basic economic concepts and the SOQ assessed students' opinions about economic issues. High Scores on the TEL indicate greater understanding of economic concepts and high scores on the SOQ indicate more conservative attitudes. A critical ratio was used to compare the mean scores for both groups on both instruments. The data revealed that students who had completed the economics course know significantly more about economic concepts and held significantly more conservative attitudes toward economic issues than students who had not studied economics. In addition, significantly high positive correlation coefficients were obtained between scores on the TEL and SOQ for both groups. Students who know more about basic economic concepts had more conservative attitudes than those who understood less about economics.

RISK-BEARING AND MORAL HAZARD IN INCENTIVE CONTRACTING

Edward A. Schroeder IV, School of Administrative Science, The University of Alabama in Huntsville, Huntsville, AL 35899.

Development of a new, large-scale product such as a weapon system involves considerable uncertainty. The U.S. Government has developed several types of contratual arrangements for use when a private contractor develops such a product. Cost plus fixed fee, firm fixed price, and incentive (sharing) contracts are three major contract types that can be analyzed with one mathematical model. Moral hazard refers to unnecessarily high costs on the contract, and can be shown to be consistent with profit-maximizing contractor behavior for incentive and CPFF contracts. Strategy options for the government to reduce moral hazard costs are discussed. Monitoring of the contractor, and raising the firm's sharing rate can reduce moral hazard, but involve costs themselves. Indirect control of the contractor's rewards from moral hazard is a promising option, but fostering increased competition for contracts does not lead to a reduction in the social costs of moral hazard.

Abstracts

ATTITUDES AND OPINIONS TOWARD DOWNTOWN FLORENCE, ALABAMA

Dr. Michael W. Butler, Dept. of Economics & Finance and Dr. William S. Stewart, Dept. of Marketing & Management, Univ. of No. Ala., Florence, AL 35632-0001. Ms. Sherry Dilbeck, Small Business Development Center, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

This study was designed to determine attitudes and opinions that people held toward downtown Florence, Alabama. Three separate populations were included in the survey. The survey was conducted with the following three groups. (]) UNA students enrolled in summer school, (2) general population of Florence and surrounding areas included in the telephone prefixes 767, 766, and 764, and (3) people employed in downtown Florence.

The first two samples from UNA students and the general population group used selected random sampling techniques and are subject to statistical testing and analysis. The levels of precision and confidence for both samples are $\pm$ .05 and 95 percent respectively, which allows us to say that we are 95 percent confident that the results are within $\pm$ 5 percent of the true population values.

The technique used to survey the people working in the downtown Florence area was a convenience sampling technique and although not amenable to statistical testing procedures it is felt the data was useful. From the data the following conclusions were in order. It seems apparent that downtown Florence has a significant image problem and that this is influencing decisions regarding shopping downtown. People that shopped downtown did so infrequently and didn't spend much money there. If downtown Florence cannot provide the services and image desired by shoppers, then there is little chance of improving the downtown economy. Bold and innovative efforts are called for.

HUMAN RESOURCES DEVELOPMENT: ITS CONTRIBUTION TO ECONOMIC DEVELOPMENT

Lena B. Prewitt, Department of Management and Marketing, University of Alabama, University, AL 35486.

The forces of change which interact in the industrial nations today are rendering the industrial society obsolete and bringing in a new post-industrial society whose most enduring characteristic is information and/or knowledge-based industries. This shifting of the foundations of the American society is a key factor in the economic problems we now face and thus poses a threat to our quality of life. But equally challenging is the emerging society based on new assumptions and values which promises to transform our total way of life in the future. If we are to maintain and improve our quality of life now and in the future, our number one response during this transition period must be larger and better investments in the education of the American population. For it will be the quality of the human mind which will produce the key resource which will sustain the new society. This key resource will be integrative thought - a derivative of the integration of information, knowledge and wisdom.

Abstracts

STRATEGIC MANAGEMENT BALANCE IN THE 80's

Keith Absher, Gerald Crawford, and Kerry Gatlin. Dept. of Marketing
and Management, Univ. of North Alabama. Florence, Al 35632.

Our economy's rate of productivity growth peaked in the mid-1960's
and has since fallen. A possible contributing factor is the shift
from a production-orientation to the 'marketing concept'. Production
oriented firms place a major emphasis on research and development of
new technologies and processes. Unfortunately the consumer is
frequently an afterthought. Firms that emphasize the marketing concept
are highly consumer-oriented. Products and processes exist to satisfy
a multitude of consumer wants. While this is desirable, there has
been a tendency for production, quality and cost control to weaken in
these firms. The literature reveals reasons for the shift from a pro-
duction orientation. Top management tends to come from marketing,
finance, or legal areas. Management is rewarded for short-run perfor-
ance. Production efficiencies are slow and long-term. Production is
viewed as a technical area for specialists. Top managers are general-
ist. Business schools offer few production courses. Business re-
searchers focus on marketing strategy more frequently than production
strategies. There are many more journal articles on marketing strategy
and they are more truly 'strategic' in nature. Most production arti-
cles deal with operations and tactical matters. With the competitive
environment that most businesses operate in today, managers can no
longer affort to view production as a neutral apparatus for turning
out goods. Production can make a significant contribution along with
marketing. It is time for a balance between the functions of market-
ing and production -- both in academia and industry.

BUSINESS: JAPANESE STYLE

Frederick A. Viohl, Dept. of Marketing, Troy State University
Troy, Alabama 36082

Japanese business practices frequently baffle many American
managers with a combination of faithful observance of time-honored
traditions, and a disciplined, almost religious business efficiency
that has catapaulted the country from "also ran" to "co-leader" among
the industrial powers of the free world. The purpose of U.S. com-
panies has always been to make money, whereas, Japanese firms are
integrated into the social system of Japan. The Japanese company
functions to benefit not only stockholders, but employers, and con-
sumers as well. The Japanese in essense practice what the U.S.
managers have preached for many years.
Within the U.S., managers are the thinkers and planners, and the
workers are the "doers." The typical company is based on an authori-
tarian, top-down structure and a philosophy of individualism that
allows for little collective responsibility. Managers typically place
career before company, advancing not only within a firm but also
moving from one company to another.
The Japanese business runs more through cooperation. Managers tend
to stay with one company and identify with its goals. Workers, who
share in profits, are seen as resources, encouraged to offer sugges-
tions and make decisions that will lead to greater output and higher-
quality goods.

Abstracts

ELECTRONIC RECORDKEEPING - FORERUNNER TO ELECTRONIC MARKETS?

Veronica Free, Field Programs Branch, NFDC, TVA, Muscle Shoals, AL 35660

Electronic marketing uses telecommunications to achieve centralized pricing (trading) without requiring centralized assembly of products. Key elements in an electronic marketing system include an accurate listing and product description and a trading mechanism such as an auction, bid-offer or other forms of negotiated trading.

Primary marketing problems of the fruit and vegetable industry include: inadequate market access to major wholesale outlets; lack of grade descriptions for produce trading purposes; poor market and price information, and fruit/vegetable perishability.

Major problems created by the introduction of electronic marketing would be resistance by brokers; large investments in program development and organization; backup need for educational programs; grade descriptions would have to be developed, and more rigid quality control would be needed.

In 1981-82, TVA's electronic marketing effort was targeted to the fruit and vegetable industry to: develop telecommunication system that could be used in trading to develop an information transfer system between decentralized wholesale vegetable markets, and to develop a system to preserve information from the electronic marketing system that is needed in a recordkeeping system for management decisions.

The experience with electronic recordkeeping was costly and impractical. However, the net working among the markets and the knowledge gained about recordkeeping needs hopefully will lay the foundation for successsful electronic marketing of produce.

CRITERIA FOR ESTABLISHING FARMERS MARKETS IN ALABAMA

W. Joe Free. Economics and Marketing Research Development Branch, TVA, Muscle Shoals, Alabama   35660.

Farmers markets as direct farm to consumer outlets date back to the mid 1600's. The occurrence of farmers markets increased until the end of World War II. After World War II, they declined because of the development of a low cost transportation system, improved refrigeration, and the rise in chain stores with centralized procurement facilities. By 1970, about 80 percent of the retail price of fruit and vegetables was for the cost of assembly and distribution. Farmers markets provided a means of reducing these costs to the community. Farmer prices were higher and consumer costs lower. A survey at 24 farmers markets in Alabama produced the following information. Most farmers that sell on farmers markets are small--average 26 acres and produce a variety of products up to 13 different crops. Farmers sell at community farmers markets because it is an easy way to access buyers and convenient to their farm. Consumers buy at community farmers markets because prices were lower and fruit and vegetables were fresher. For a farmers market with a small open structure and no hired support labor to succeed, the market should have 10-15 producers that sell regularly during the entire market season and 300 or more customers that patronize the market during the peak season.

Abstracts

MANAGEMENT ACCOUNTING EDUCATION AT THE GRADUATE LEVEL

Desta Damtew, Dept. of Accounting & Finance, Ala. State Univ., 36195

Management accounting courses can be offered in three distinct programs at a graduate level. These include: (1) the regular master's, (2) continuing education, and (3) doctoral programs. Since the primary objectives of each of these programs are different, the purposes of the courses are often different. Likewise, the teaching methods and materials used in each of the programs are also different. For instance, the lecture and case approaches of teaching are considered effective in the master's and continuing education classes. On the other hand, the seminar approach of teaching is usually accepted as the most appropriate for the doctoral classes. Furthermore, the level of sophistication and abstraction increases as one compares the materials for continuing education class with those for the doctoral program. The emphasis in the continuing education class is on techniques and procedures. Thus, the materials for continuing education class will be mostly of pragmatic nature. The content of the materials for the doctoral class will be generally conceptual and abstract in nature. In addition, the establishment of an increasing number of "Professional Schools of Accountancy" is expected to have a positive impact on the breadth and types of materials to be covered at the graduate level. On the whole, due to the continuously increasing emphasis on attaining certification (C.P.A., C.M.A., C.I.A.), the content and rigor of the future post-baccalaureate level programs in management accounting will be significantly enhanced.

PREDICTING PERFORMANCE IN REAL ESTATE SALES

Kerry P. Gatlin. Department of Management and Marketing, University of North Alabama, Florence, Al 35632.

The relationship between personality, background and performance as determined by an examination of correlation coefficients, Ordinary Least Squares Analysis, Linear Probability Analysis and Principal Component Analysis reveals:

1. A significant correlation between performance and experience, time spent at work, source of income (primary), number of hobbies (negative), number of jobs last 10 years (negative), parents in real estate (negative) and formal education.

2. A significant correlation between performance and number of unfavorable adjectives in a self-description, nurturance (negative), autonomy, exhibition, abasement (negative), affiliation (negative) and achievement drive.

3. Linear Probability Analysis equation correctly classifies 88.7 percent of low-productivity group and 75.5 percent of high-productivity group. Variables in equation: number of unfavorable adjectives in self-description, time at work, experience, achievement drive, parents (not) in real estate, formal education and exhibition drive.

Abstracts

COMPUTER PROJECTION OF BUDGETS FOR AN ALABAMA CATFISH FARM

David Hunt*and Gregory Sullivan. Dept. of Agricultural Economics and Rural Sociology, Auburn Univ., AL 36849.

An investigation was made into the long-term profitability of a middle-sized West Alabama catfish farm under 3 different harvest timing strategies. The Texas A & M University Aquaculture Budget Simulator was used to project the economic performance of the farm over a 10-year planning horizon. Harvest strategy 1 was the system of monthly harvesting (topping by nets) currently in use on the farm. Harvest strategy 2 assumed harvesting only during September, October, and November ceteris paribus. Harvest strategy 3 assumed harvesting only during the month of October ceteris paribus. Primary data was collected by converting the Simulator user manual into a questionnaire which was then administered to the manager of the catfish farm.
    Several widely-used financial criteria were used to compare the growth of the farm under the 3 scenarios at the end of 10 years. An effort was also made to alter the model to consider more than one annual set of monthly harvest prices received. Harvest strategy 1 yielded the highest annual average rate of growth of initial equity. Harvest strategy 2 yielded the next highest rate of growth, and harvest strategy 3 yielded the lowest annual rate. Analysis was done on the basis of gross revenue net of production costs before taxes. The 3 harvest strategies chosen for scrutiny reflected varying degrees of effort by the farm manager to exploit seasonal price incentives offered by catfish processors.

METHOD OF ESTIMATING DISK SEEK TIME

C. L. Friese. Dept. of Information Systems and Decision Science, Auburn University in Montgomery, Montgomery, AL 36193.

   The design and analysis of applications that utilize large disc files on modern large computer systems is a complex topic that has received much attention. A critical part of the performance analysis is the estimation of the disc seek time which is a significant, indeed often the major component, in the estimate of record access time. The discussion will be restricted to this critical part of the analysis, namely the estimation of disc seek time. A derivation of the probability distribution function for arm movement will be presented. This will be based on an assumption of uniform probability of random access. A specific example of an assumption of a biased probability of access will also be utilized to compute a probability distribution function for arm movement. These probability distributions will be utilized to compute the expected seek times utilizing the assumption of linear time found in the literature, as well as a non-linear model obtained in a private communication from the hardware manufacturer. Both models will be utilized in specific design analyses for both 3330 and 3350 discs to show that an "optimal" design would not be significantly affected. The estimates of performance would, of course, be different.

Abstracts

INTEREST RATE EXPECTATIONS FOR THE 1980's

Macon Wilbourn, Dept. of Acctg. & Finance, Auburn Univ. at Montgomery, Montgomery, Alabama 36193.

Market or nominal interest rates are generally accepted as being comprised of two components: the real rate of interest plus an inflationary premium. The real rate is determined by the productivity of capital and the positive time preference of individuals. This rate has historically remained within the relatively narrow two-to-three percent range. Current studies, however, indicate that the real rate is changing. Such changes must, of necessity, be symptomatic of changes in the real rate's causal variables -- the productivity of capital and/or positive time preference.

The inflationary premium is simply the additional percentage, or premium, that lenders demand in an attempt to insure repayment in equivalent purchasing power. This premium is a function of inflationary expectations, and has been the primary component of nominal rates for some time.

Because of this latter factor, nominal interest rate projections should begin with an assessment of inflationary expectations. One should then proceed to categorize and analyze the long-term structural changes in society that may be affecting the real rate. As a beginning, this writer suggests a consideration of three events: the change from a seller's market to a buyer's market, the Keynesian revolution, and the economic emergence of the third-world.

SOCIAL IMPLICATIONS OF HIGH TECHNOLOGY - AN OVERVIEW

Norman Marcus, Management/Marketing, Univ. of Ala., Huntsville, AL 35899.

"The allure and romance of technology for technology's sake can be compelling. While we should and will, continuously explore the new frontiers available through advancing technology, as practical businessmen and women, and as responsible citizens, we must seek to avoid the consummate waste that is an inevitable consequence to technology rambling in search of a market." (Alfred D. Scorpio, Lisbon IAA World Meeting, 1974) An examination of this pronouncement, some consideration of the frequently expressed concern over unlawful undesirable and "too-easy-access" to confidential data; the discussion concerning increased leisure time and less employment opportunity as a result of technological innovation in "Work Places"; all these areas of concern are considered. However, the main thrust of the research and writing concern developments which relate to Human communication and Social communication. The resulting two-way communication, better understood as a result of extensive work and research in communications studies should not be impaired by developments in communications related to high technology. Other aspects of the evolution, progress and prospects in high technology, as they effect individuals, society and the environment, are also considered.

Abstracts

THE VALUE OF ATTITUDINAL VARIABLES IN LABOR MARKET STUDIES
Philip Gregorowicz, Dept. of Economics, AUM, Montgomery, AL 36193

Attitudinal variables reflecting individual attitudes about their jobs, conditions of employment, and other aspects of the work environment are becoming more commonly used in standard labor market studies. For example, general job satisfaction indexes have been used to explain labor market behavior and outcomes such as quit rates, unionization and strike activity, income-leisure choices, and wage differentials. Attitudinal type variables are likely to be more commonly used in the future, if for no other reason than their greater availability in labor market data sets.

The value of such variables in economic research is uncertain due to the subjective nature of these variables. Attitudinal variables, if they are to be meaningful in explaining labor market outcomes must provide new information or reflect unmeasured objective conditions affecting behavior.

The purpose of this analysis is to estimate job satisfaction functions in order to determine the importance of various factors on individual responses to job satisfaction questions. A new data set was used to estimate various forms of job satisfaction function for male and female workers. These empirical results should provide information on whether such variables have any systematic independent variations and connection to variables of interest to economic researchers.

SCIENCE EDUCATION

LOGARITHMIC GRAPHING IN THE PHYSICS CLASSROOM

W.J. Reid. Department of Physics, Jacksonville State University, Jacksonville, AL 36265.

Full logarithmic (log-log) plots provide a versatile tool for investigating functions of the form $u = kv^n$, often called power laws. By combining their use with an experimental approach, one can empirically determine many of the useful relationships of introductory physics, such as those governing the pendulum, simple harmonic motion, vibrating strings, centripetal force, linear acceleration, etc. One is then free to elaborate on the physical principles producing the relationship. An added virtue is the ease with which the technique can be mastered by the mathematically inept, while simultaneously retaining the interest of the more sophisticated. Further,significant figures "take care of themselves", order and regularity is visually displayed, precision is cultivated, and prediction with subsequent verification is an obvious extension. The procedure will be described and illustrated.

A STUDY OF THE SCIENTIFIC, TECHNOLOGICAL, AND ECONOMIC USES OF NEAR-EARTH SPACE AS A CURRICULUM FOCUS FOR MIDDLE SCHOOL SCIENCE

Ernest D. Riggsby and Dutchie S. Riggsby, Columbus College, Columbus, GA

Information secured from the Skylab program, the Earth Resources Technology program, and the Space Transportation System (Space Shuttle) program combine well to advance the state of the art in the fabrication of materials, surveying of earth's resources, detecting and measuring oceanic and atmospheric pollution, and in the development of high-technology for research, development, and utilization of conditions not available on the surface of the earth. Students are stimulated to learn about the exotic processes and materials which are evolving from such environments. Educational materials available from the National Aeronautics and Space Administration, the National Air and Space Museum's Educational Materials Center, and from the Center for Aerospace Education Development of the Civil Air Patrol make it feasible for a middle school science teacher to incorporate these areas of interest directly into the existing curriculum. This paper addresses this topic and offers suggestions for such teaching.

RESEARCH ABOARD THE OREGON II

Joy D. Gilder, University of North Alabama, Florence, AL 35630

This paper describes the research techniques of Cruise # 129 and the third leg of Cruise # 130 aboard a research vessel, the OREGON II, operated by the National Oceanic and Atmospheric Administration (NOAA). The 170-foot ship is berthed at the Pascagoula, Mississippi laboratory of the NOAA Southeast Fisheries Center. Cruise # 129 dealt with population surveys of snapper and grouper. The sampling took place along the northern coast of Puerto Rico and in the Caribbean Sea near the U.S. Virgin Islands. Longlines, traps, and handlines were used. Groundfish were the main emphasis of study on Cruise # 130 which took place in an area just off the coast of Mobile, Alabama to the Texas-Louisiana state line in the Gulf of Mexico. Species were captured with trawl nets. Sampling stations were selected in the area of research before the cruises began. At each station, environmental data was collected such as sea conditions and weather conditions. After species were captured, biological data was obtained and recorded. The ship was well-equipped with different types of scientific instruments. The experience, as a member of the scientific crew aboard the OREGON II, was very interesting as well as educational.

Abstracts

KNOWLEDGE OF METRIC UNITS OF MEASURE AND THEIR APPLICATION

Robert E. Rowsey and Loren L. Henry*. Dept. of Curriculum and Teaching, Auburn University, AL 36849.

Little emphasis has been placed upon the assessment of subjects' knowledge of relationships among SI units or to the application of metric measures to everyday situations. To assess current knowledge and application of SI units three distinct age level groups of students were examined. One group consisted of senior level college students who were perspective mathematics and/or science teachers. Another group was composed of high school students enrolled in chemistry and physics classes. The last group consisted of high ability eighth grade junior high school students. Data collected by means of the Metric Relationships Instrument (MRI) and the Metric Applications Instrument (MAI) indicated the following results. (1) There was significant difference at the 0.001 between performance on the MRI and MAI for each of the three groups studied. (2) There was no significant difference in performance on the MAI for college subjects compared to high school subjects. There was significant difference in performance at the 0.05 level when high school students were compared to junior high school students. The difference in performance of the junior high group compared to the college group was significant at the 0.001 level. (3) There was no significant difference in performance on the MRI between either the college group compared to the high school group or the high school group compared to the junior high school group. Significance was found at the 0.05 level when the performance of the college subjects was compared to that of the junior high school subjects.

HEALTH SCIENCES

INDUCTION OF DIPLOCHROMOSOMES IN LYMPHOCYTES TREATED WITH CPZ

Velma B. Richardson, Dept. of Biology, Tuskegee Institute, Tuskegee Inst., AL 36088 and Jack E. Watson, Dept. of Zoology-Entomology, Auburn Univ., Auburn, AL 36849.

The effect of chlorpromazine hydrochloride (CPZ), a psychoactive phenothiazine, on the incidence of chromosomal aberrations (CA's) was investigated using the short-term peripheral blood culture assay. Cells cultured in growth medium containing ten-fold increases in CPZ concentration ranging from 0.05 to 5.00 $\mu g/ml$ showed an increase in the incidence of chromosomal aberrations over control cultures. Concentrations of CPZ that elicited the greatest increase in CA's also showed the greatest increase in the percentage of cells with abnormal mitoses. Drug-induced polyploidy was observed at all concentrations but did not show a dose-response effect. The occurrence of CPZ-associated endoreduplication suggests that in addition to reacting with DNA, CPZ may also interact with components of the mitotic apparatus.

Abstracts

EFFECT OF HOSPITAL ADMISSION PROCEDURES ON PATIENTS' ANXIETY AND SATISFACTION

Lynne G. Faulk. University of South Alabama.

A systematic investigation was conducted comparing the impact on patients of three hospital admission procedures. Are patients who have been given specific information during admission less anxious and better satisfied with their admission than those whose admission focused on eliciting personal feelings about illness and hospitalization, or those who have been routinely admitted? The purpose was to document the effects of giving patients information about the hospital system, of clarifying expectations for them in their new role, and of demonstrating equipment in the immediate hospital environment.

Ninety medical surgical patients scheduled for elective admission to a general hospital were randomly assigned to one of three admission treatment groups. Two were experimental conditions--termed the information-giving admission and the concern-for-patient-feelings admission. One control group involved routine admission. Systolic blood pressure, pulse rate and state anxiety measures were collected before and after admission for all three groups. Satisfaction with admission questionnaires were completed by patients after admission.

Multivariate and univariate analyses of variance and covariance were conducted to test the hypotheses. There were no significant ($p < .05$) differences among the three types of admission groups, means on state anxiety, systolic blood pressure and pulse rate after treatment.

The hypothesis related to admission treatment effect on patient satisfaction was accepted. The information-giving admission procedure was significantly ($p < .01$) more satisfying for patients than either the concern-for-patient-feelings admission or the routine admission. Furthermore, patients admitted in the concern-for-patients feelings groups were significantly ($p < .01$) more satisfied than those experiencing the routine admission.

The quality of nursing care provided by an information giving orientation for patients upon admission to the hospital is supported by this study. The nursing teaching function of orienting patients humanized the hospital experience and helped promote the patients' well being.

ADRENAL HEMORRHAGE COMPLICATING ANTICOAGULANT THERAPY

William W. Winternitz. Dept. of Internal Medicine, College of Community Health Sciences, University, Alabama 35486

Anticoagulant associated adrenal hemorrhage (AAH) is an infrequent complication of therapy. It is not usually diagnosed pre-mortem, but can be successfully treated if recognized. A case is presented and the literature is reviewed with emphasis on the pathogenesis, clinical picture, diagnosis and treatment. This may be the first case with histological study after long-term survival of the initial episode.

In Vivo Demonstration of An Antibody
Independent Protective Mechanism to Herpes
Simplex Virus Infection. H.L. Mizelle and
W.B. Davis. University of South Alabama
Mobile, AL 36688

Intraperitoneal (IP) administration of a sublethal inoculum of herpes simplex virus type 1 (HSV) 48 hours prior to challenge with a lethal dose of HSV-2 prevents a fatal infection from occurring in 28 day old Balb/C mice. The basis for the rapidly induced protection was studied. Peritoneal exudate cells (PEC) were harvested at intervals following IP inoculation of 1 x 10^6 plaque forming units (PFU) of HSV-2. The number of PEC infected were determined by overlaying washed adherent PEC with vero cells and counting the plaques formed (infectious centers) after 72 hours incubation. The infectious centers produced by PEC recovered from HSV-2 infected animals increased from 131/5 x 10^5 PEC at 3 hours postinfection to greater than 300 at 6 hours; however, the quantity of infectious centers per 5 x 10^5 PEC declined at each subsequent time interval becoming non-detectable at 24 hours. Passive transfer of HSV-2 specific antibody did not reduce the level of infectious center formation observed at 6 hours whereas administration of 250 mg/Kg of adenine arabinoside reduced infectious center formation to less than 20/5 x 10^5 PEC. PEC harvested from animals 6 hours after a second HSV-2 challenge, given 48 hours following the first, did not produce infectious centers. Further, adoptive transfer of 5 x 10^6 PEC obtained from mice infected IP 48 hours previously, prevented infection of PEC when the recipients were challenged with virus.

This study shows that local defense mechanisms to eradicate HSV-infected cells evolve within 24 hours following virus inoculation. The protective mechanism operates independently of antibody but appears to involve cells and/or their products.

VIRILIZING ADRENAL CORTICAL TUMOR IN A PATIENT WITH NEUROFIBROMATOSIS

Elizabeth C. Stevenson with William W. Winternitz. College of Community
Health Sciences, The University of Alabama, University, AL 35486.

25 year old white female with neurofibromatosis presented with amenor-rhea, virilism, tachycardia, and hypertension. Studies indicated presence of an androgen secreting tumor. CT Scan of abdomen revealed a large ad-renal mass on the right and a normal size adrenal on the left. An 8.5 cm adrenal cortical adenoma was surgically removed. The clinical and patho-logic features of neurofibromatosis are reviewed with emphasis on the in-cidence of neoplasia. Theories concerning tumor pathogenesis are discussed

Abstracts

Homology of Varicella-Zoster Virus DNA with DNAs of Human
and Simian Herpesviruses. Wayne L. Gray and John E. Oakes,
University of South Alabama College of Medicine, Mobile,
AL 36688.

Varicella-Zoster virus (VZV) is the etiologic agent of
human chickenpox and shingles. Studies have shown that VZV is
antigenically related to simian herpesviruses that cause a
varicella-like exanthematous disease in non-human primates.
More recently studies have suggested that VZV may possess
cross-reacting antigens with herpes simplex virus (HSV). We
report here the results of studies designed to demonstrate
homology of VZV DNA with the DNA of two simian varicella
viruses, Delta herpesvirus (DHV) and Medical Lake Macque
virus (MLM), and with HSV type 1 and HSV type 2. DNA isolated
from VZV, DHV and MLM infected cells was restricted with
Hind III endonuclease and transferred to nitrocellulose paper
by the Southern Blot technique. Hybridizations with a ^{32}P-
labeled VZV probe were carried out at 35°C in a range of
formamide concentrations. At the 50% formamide level no
homology was detected between VZV and simian varicella DNAs.
At 40% and 30% formamide concentrations the VZV probe
hybridized to at least eight simian varicella Hind III frag-
ments. Under similar hybridization conditions no DNA homology
was detected between VZV and herpes simplex virus. Further
studies using cloned VZV Hind III fragments as probes
indicated that the DNA homology between VZV and Delta herpes-
virus is distributed across the genome. These results demon-
strate that VZV and simian varicella virus share DNA homology
and indicate a close evolutionary relationship between VZV and
simian varicella viruses.

UTILITY OF GLYCOHEMOGLOBIN IN DIABETES MANAGEMENT

Frances S. Breslin and Robert E. Pieroni. Dept. of Internal Medicine,
College of Community Health Sciences, Univ. of AL 35486

Juvenile and adult diabetic (type I and type II) outpatients were seen in
a family practice setting. The records of these patients were examined for
multiple, concomitant plasma glucose and glycohemoglobin (GHb) analyses.
Thirty-seven patients were found to have such corresponding tests. There
was a significant positive correlation between these diabetics' plasma
glucose and GHb concentrations. The GHb analyses, useful indicators of
long-term glycemic control, were effective in detecting several patients'
dietary non-compliance.

THE ROLE OF THE FAMILY PHYSICIAN IN THE CARE OF THE CHRONICALLY MENTALLY ILL.

L. Ralph Jones, Lee W. Badger, Harry J. Knopke, and Deborah R. Coggins, University of Alabama.

Amid the ruins of a mental health care delivery system chronically beleaguered by inadequate planning, financial support or public consensus, efforts to integrate mental health services with the health services of primary care physicians are considered the best hope to improve access to mental health care. Comprehensive planning for mental health services to underserved populations must consider the shortage and maldistribution of psychiatrists, requirements for professional and liaison support for effective mental health care delivery by primary care physicians, access to continuing education, and reimbursement for appropriate mental health services. There is increasing evidence of need for active involvement by family physicians in the care of the chronically mentally ill. A national survey of the 382 AAFP residency programs was conducted by the authors to assess the current status of mental health training of family physicians. A 64 percent return, distributed almost identically to the survey population, allows generalization to all residency programs. An alarming finding is that over half of the family practice programs do not address management of the deinstitutionalized chronically mentally ill at all. Considering the progress of deinstitutionalization, with a focus on community-based care, as well as the present political and economic climate, it is particularly important that curricula in medical education be designed to prepare primary care physicians to assume an active role in the management of the chronically mentally ill.

AN INFLUENZA VIRUS LATEX AGGLUTINATION PROCEDURE

Don Roush. Dept. of Biology, Auburn Univ. at Montgomery, Montgomery, AL 36193. L.A. Magee and F.Tamago-Caddeo. Dept. of Biology, Univ. of Mississippi, University, MS 38677

The effect of buffer at various pH values and temperatures with known concentrations of Influenza Virus Type A (strain PR8) were examined in a latex agglutination procedure. The buffer used was a glycine-saline buffer. The working suspension of polystyrene latex particles (PSL) at a pH value ranging from pH 6.2-9.0 was incubated with specific antisera in a standard agglutination test at 4°C and 38°C. Under the test conditions, the PSL-virus agglutinated best at pH 6.2 with 48 HA units of virus. The reaction was more stable at 4°C than at 38°C.

Abstracts

PROJECTED NEED FOR PRENATAL CYTOGENETIC STUDIES IN ALABAMA

C. H. Barganier, Laboratory of Medical Genetics, University of Alabama
in Birmingham, Birmingham, Alabama 35294. C. B. Hale, School of
Public Health, University of Alabama in Birmingham, Birmingham,
Alabama 35294. S. C. Finley and W. H. Finley, Laboratory of Medical
Genetics, University of Alabama in Birmingham, Birmingham, AL 35294.

Utilization of prenatal genetic studies for diagnosis or exclusion
of fetal chromosomal disorders has become more accessible during the
past decade. Current capabilities permit in utero detection of
virtually all known chromosomal disorders. The procedure is indicated
for pregnant women at known risk for fetal chromosomal disorders and
usually occurs at 16-18 weeks gestation. Numerous studies have demon-
strated correlation between advancing maternal age and the incidence
of fetal chromosomal anomalies such as Down syndrome. Consequently,
75 percent of prenatal genetic studies delivered nationally are
indicated because of advanced maternal age, usually defined as age 35
or greater. This procedure is becoming increasingly requested from
medical genetics centers and a major policy concern is to anticipate
future need and demand. A ten year planning model was developed to
project by region Alabama's annual need for prenatal genetic studies
due solely to advanced maternal age. The model predicts a 36.5 per
cent increase in births among women $\geq$ 35 years of age from 1982 to
1991. Although the highest rate of increased need will occur in the
southern half of Alabama, the largest total numerical need will exist
among residents of the northern half of the State. Suggested policy
implications from this anticipated trend will be presented.

HYPOKALEMIC PERIODIC PARALYSIS: CASE REPORT & REVIEW OF LITERATURE

Van Johnson and William W. Winternitz. Department of Internal Medicine,
College of Community Health Sciences, University of Alabama, University,
Alabama 35486.

A case of apparently sporadic hypokalemic periodic paralysis (HoPP)
is presented and the clinical characteristics and pathophysiology of this
disorder are reviewed from the literature. The disease primarily occurs
in young males and is characterized by sudden onset of voluntary muscle
paralysis occurring with a sudden shift of potassium into the cells. The
attacks mainly occur upon awakening from sleep or after a large carbohy-
drate meal. The primary treatment to prevent recurrences of this disorder
is to create a metabolic acidosis with acetazolamide. Many questions re-
garding the nature of the disease remain unanswered.

Abstracts

EMOTIONAL INDICATORS ON CHILDREN'S DRAWINGS

Joanne B. Scungio, School of Nursing, Univ. of Ala. in B'ham, 32594.

A drawing captures symbolically on paper many of children's thoughts and feelings about themselves or significant others, which they cannot express in speech or writing. This descriptive study sought to compare the number and type of emotional indicators (EI) leukemic and healthy children included in their figure drawings. The sample was comprised of 40 randomly selected school-age children; 20 with acute lymphocytic leukemia and 20 healthy children residing in Southern New England. Children's human-figure(HF) and self-figure(SF)drawings were used as the data collection tools. A 3-way ANOVA was used to determine the differences of children's mean EI scores. Findings of the study indicated that leukemic children included: (a) significantly more EIs on their HF and SF drawings than did healthy children, (b) significantly more EIs on their SFDs than on their HFDs, (c) such EIs as, poor integration of body parts, shading of the body and/or limbs, hands cut off, and arms clinging to sides on their HFDs, and (d) such EIs as, shading of the face, tiny figures, omission of nose, mouth, hands, feet, neck, and/or hair, crossed eyes, and short arms or legs on their SFDs. Age and sex were not contributing factors in the differences found between the leukemic and healthy children's HF and SF drawings. Results of the study suggest that the ramifications of a chronic illness such as leukemia produce numerous emotional stressors in the school-age child. Drawings can provide the nurse with an assessment of children's ideas regarding their own situation. Once the data have been obtained and interpreted, the nurse must use the information to guide future interactions and interventions with the child and the family.

TREATMENT OF DECUBITUS ULCERS WITH GALVANIC STIMULATION

Ed Hanson. West Alabama Rehabilitation Center, Tuscaloosa, AL 35401. Robert Pieroni. Dept. of Internal Medicine, College of Community Health Sciences, Univ., AL 35486.

Decubitus ulcers are areas of ischemic or anoxic tissue necrosis resulting from any continuous, imposed pressure that may occlude venules and arterioles. Decubiti are particularly common and serious problems in individuals with decreased sensitivity and peripheral vascular insufficiency. They result in considerable expense, morbidity and mortality. Although many methods are used to treat decubiti, therapeutic failures are common. Electrotherapy has resurged in the past decade for treating a variety of medical conditions. Results using high voltage pulsed galvanic stimulation on patients with severe decubiti are encouraging. This modality appears to accelerate healing and improve infection control.

Abstracts

EFFECTS OF MARINE ω-3 FATTY ACIDS ON PLASMA LIPIDS

B.E. Phillipson. CCHS, Univ of Ala, Tuscaloosa, 35486. W.E. Harris*, W.E. Conner.* Univ of Oregon Health Sciences Center, Portland, Oregon 97201.

The purpose of this study was to assess the effects of a diet high in ω-3 fatty acids (FA) upon the plasma lipids of patients with combined hyperlipidemia. Previously we had found that normal subjects had both a decrease in plasma cholesterol (C) and triglyceride (TG) levels from dietary ω-3 FA (C20:5 and C22:6). Fourteen patients (7 with type II-b and 7 with type V) received a 100 mg cholesterol, 20% low-fat diet; the type V patients were fed a 5% fat eucaloric diet until chylomicronemia had resolved. Next, a diet containing salmon and salmon oil, high in ω-3 FA, and with a fat content ranging from 20-50% of total calories was fed for 9-28 days.

Plasma Lipid Changes from Salmon Oil (mg/dl)

	C	LDL-C	TG	VLDL-TG
Type II-b	368→270	272→212	345→115	240→40
	-26%	-22%	-67%	-83%
Type V	303→190	55→95	1252→326	998→205
	-34%	+73%	-74%	-79%

The plasma C decreased in both type II-b and type V patients. More striking was the fall in TG. This was mirrored also by the great decline in VLDL-TG. LDL-C declined in II-b but rose in type V as ω-3 FA apparently hastened the catabolism of VLDL to LDL. This hypolipidemia action of a marine oil suggests that fish in the diet and fish oil might have a beneficial effect in combined hyperlipidemia.

CREUTZFELDT-JAKOB DISEASE PRESENTING AS PSYCHOTIC DEPRESSION

Hemp, J.W.* and Todorov, A.B. College of Community Health Sciences, Univ of Alabama, Tuscaloosa, 35486.

A challenging exercise in medicine is the differential diagnosis of the patient with altered mental status. This is important when the patient has a treatable organic or psychiatric condition, as well as for prognostic purposes. Thus, when a psychotic patient presents to the primary care physician, there are a number of diagnoses which must be ruled out.

This paper describes a case of Creutzfeldt-Jakob disease. It illustrates the need for a careful history and physical examination. One must keep an open mind toward the psychotic patient who does not respond to conventional therapy.

THE EFFECT OF EXERCISE TRAINING UPON VENTRICULAR ECTOPIC ACTIVITY

Ann Clotfelter, Howard Horn*,Baptist Medical Centers, B'ham, Ala. 35213

To evaluate the hypothesis that exercise training (ET) of patients
with coronary disease may have the potential to reduce the severity and
frequency of ventricular ectopic activity (VEA), 32 males and 1 female
underwent symptom-limited graded exercise testing before and after a
12 week monitored exercise program. Using the Bruce protocol, VEA was
measured during a 3 minute control phase, the exercise phase, and a 10
minute recovery phase. All patients were coronary artery disease
patients with a history of myocardial infarction, coronary artery by-
pass surgery or angina. The average age was 60.

Functional capacity as measured by treadmill duration increased 42.5%
Overall, using Lown VEA grading, Grades I & II were decreased an average
of 87% in seventy six percent (25) of the participants following ET,
while eighteen percent(6) increased their VEA and six percent (2) showed
no change. All participants with VEA present in the control phase
showed a decrease in the amount of VEA. Seventy-one percent (20)
decreased Grade I & II ectopy during the exercise phase while twenty-
five percent (7) increased. Grade 4A (couplets) decreased during the
exercise phase by 87% in 83%of the sample after ET and no Grade 4B
(Ventricular tachycardia) occured at any time. During the recovery
phase, Grades I & II decreased in 57% of the sample, increased in 21%
of the sample, and did not change in 21%.

This study demonstrates that exercise training of coronary patients
can improve functional capacity and appears to decrease both frequency
and grade of VEA as assesed by treadmill exercise testing.

GEOGRAPHIC VARIATIONS IN TETANUS AND DIPHTHERIA IMMUNITY

C.T. Thames and R.E. Pieroni. Dept. of Internal Medicine, College of
Community Health Sciences, Univ., AL 35486. R.S. Stinson. Dept. of
Microbiology, Univ., AL 35486. J.D. Leeper. Dept. of Community Medicine,
College of Community Health Sciences, Univ., AL 35486.

Serum was randomly obtained from 160 patients of varying ages at three
family practice centers from geographically diverse areas (Texas, Michigan
and Tennessee). The serum was evaluated for protective antibodies against
tetanus and diphtheria using the Enzyme Linked Immunoabsorbant Assay (ELISA)
procedure. There was a highly significant inverse relationship between
patient age and protective antibody levels against both tetanus and
diphtheria. Locality and sex were found to have considerably less influence
than did age. The practical as well as educational benefits obtained from
this survey will be discussed, as will a comparison of results with previous
related surveys conducted in Alabama.

USE OF PLASMA-ETCHING TO EXPOSE INTRACELLULAR DENTAL FOR SEM

David E. Steflik, Ralph V. McKinney, Jr., Baldev B. Singh and David L.
Koth. Departments of Oral Pathology and Restorative Dentistry, School
of Dentistry, Medical College of Georgia, Augusta, GA   30912

Our laboratories have been investigating the host tissue response to
endosseous dental implants. Traditional modalities of electron micro-
scopy have elucidated much of this response, however, SEM data needed to
be garnered from entire biological specimens containing the in situ bio-
material. Surface etching of such plastic embedded specimens by oxygen
plasma has allowed us to examine this interface as well as permitting us
to observe intracellular detail by SEM. After routine SEM/TEM/LM pre-
paration and analysis, the specimens were subjected to oxygen plasma
produced from oxygen gas by a radiofrequency generator. This procedure
removed the plastic embediment, exposing surface topography and allow-
ing SEM analysis. Excellent preservation of crevicular epithelium dif-
ferentiation was observed, including well defined nuclear regions. Nu-
clear membrane morphology was retained, replete with nuclear pores, sur-
rounding chromatinous material. Crevicular gingiva contained small
amounts of isolated leukocytes, some exhibiting phagocytosis, sympto-
matic of a filtering theory of gingival function. Minimal bacterial in-
gression could be recognized. These data suggest that tissues juxta-
posed to the implant appear similar to tissues adjacent to natural
teeth, thus corroborating our previous observations suggesting excellent
implant biocompatability. Further, this study suggests an important
role for this technique in implantology research, as well as for corre-
sponding scientific research; particularly epithelial differentiation.
Study supported by Kyocera, Inc. Grant No. 7834-0001.

PRENATAL DIAGNOSIS OF PARTIAL TRISOMY 15: A CASE REPORT

Paula C. Vinson, Sara C. Finley, Laboratory of Medical Genetics,
Richard O. Davis, Department of Obstetrics and Gynecology, UAB,
Birmingham, Alabama 35294, Jerry D. Dillard, Selma, AL   36701

At least 24 cases of partial trisomy 15 have been reported. These
cases vary as to break points on the 15q, but the majority have a
break point of q21 or 22. Clinical findings in these cases are
also variable. Certain features are present more frequently than
others. These include mental retardation, hypotonia, strabismus,
high arched palate, micrognathia, incurving 5th finger, and hyper-
activity. The literature will be reviewed. A new case of partial
trisomy 15 will be presented. This case was detected by prenatal
chromosome studies. Subsequent chromosome studies on the mother
revealed a 46,XX,t(7;15)(q22;q21) karyotype in all cells examined.
Clinical findings in the fetus will be discussed.

SPECIFIC SELENIUM BINDING PROTEINS OF RAT TISSUES

Brahma P. Sani*, Chandra K. Banerjee*, and L. Lee Bennett, Jr.,
Biochemistry Dept., Southern Research Institute, Birmingham, AL 35255

The anticarcinogenic and therapeutic potential of selenium (Se), a micronutrient, has been well documented in various test systems. Dietary supplementation of Se reduces the cancer incidence in colon, intestine, liver, skin and mammary gland. The biochemical mechanism of its action, however, is not known. In an attempt to understand this, we investigated the in vitro interactions of Se with rat tissue extracts. The 100,000 x g supernatant of colon and intestine after incubation with $Na_2[^{75}Se]O_3$ and chromatography on Sephadex G-100 column produced 3 radioactive peaks corresponding to molecular weights of 17,000, 68,000 and >90,000. The 17,000 peak corresponded to a protein which sedimented in the 2 S region of a 5-20% linear sucrose gradient. The 2 S protein resolved from the Sephadex G-100 column bound 0.3 mole of Se per mole of 17,000 dalton protein. This specific binding of Se was stable to dialysis in buffers of pH 6-11, to Sephadex, ion exchange and electrofocusing columns. The binding was, however, sensitive to thiol inhibitors such as p-chloromercuriphenyl sulfonic acid (1 mM) and iodoacetamide (2 mM). The mercurial inhibition was reversible on treatment with dithiothreitol. Chromatography of rat serum yielded only two radioactive peaks corresponding to 68,000 and >90,000 daltons. Comparison of the chromatographic profiles of serum and intestine suggests that the two heavier binding proteins in the intestinal extracts are originated from serum contamination. The 2 S binding protein of intestine and colon may mediate some of the cellular functions of selenium, similar to the hormone and vitamin receptors. The plasma binding proteins may mediate the transport of selenium to various tissues.

WIC PROGRAM EFFECTIVENESS IN ALABAMA

James D. Leeper, Sarah T. DeMellier, Tamar Milo, and Terence R. Collins,
College of Community Health Sciences, University of Alabama,
University, AL 35486.

In order to determine the effect of participation in the Women, Infant, Children (WIC) supplemental food program on health care utilization and pregnancy outcome, a total of 519 pregnant women were interviewed during public health department clinic visits in six Alabama counties. Of the sample, 341 women were WIC participants and were, therefore, at nutritional risk; 178 were non-WIC controls who were not at nutritional risk. Health care utilization patterns and pregnancy outcome were not significantly different between the two groups. In fact, mean weight gains differed by less than a pound and mean birth weights were identical. WIC is effective in overcoming nutritional risk and improves pregnancy outcome, but its educational component needs to be strengthened to improve utilization.

THE SINGLE CRYSTAL SAPPHIRE ENDOSSEOUS DENTAL IMPLANT: CLINICAL AND MORPHOLOGICAL RESPONSE

Ralph V. McKinney, Jr., David E. Steflik, Baldev B. Singh and David L. Koth. School of Dentistry, Medical College of Georgia, Augusta, GA 30912

The purpose of this study was to evaluate the single crystal sapphire endosteal dental implant after two year trials in the jaws of dogs. The implant is a crystalline alpha alumina oxide (Al_2O_3) material fashioned in a cylindrical shape with a threaded root portion and cervical shoulder. Third and fourth premolars were removed in 18 mongrel dogs and, following healing, 36 sapphire implants were inserted. The teeth were brushed twice weekly. Beginning at one month the following clinical parameters were evaluated: gingival inflammation (0 to 3+), plaque accumulation (0 to 4+), crevicular fluid volume (0 to 40 units), mobility (0 to 4+) and radiographic appearance. The adjacent first molar served as a control. The evaluation averages at two years were: implant gingival inflammation +0.6, control +0.8; implant plaque +1.0, control +1.4; implant crevicular fluid volume 7.2 units, control 11.7 units. Two implants had a mobility of 2+ and two had 1+ mobility. Light and electron microscopic examination showed good bone or connective tissue adaptation to the implant root and in some specimens bone regeneration on the superior aspect of the implant cervical shoulder. High resolution microscopy utilizing TEM and SEM revealed the presence of epithelial pseudopods in contact with the biomaterial. These epithelial cells showed the presence of a protein-polysaccharide coating and hemidesmosomes. Data from this investigation indicates the implants are compatible with bone and soft tissue and meet minimal clinical standards for success. Study supported by Kyocera, Inc. Grant No. 7834-0001.

PLUMBISM AND ILLICIT ALCOHOL CONSUMPTION IN WEST ALABAMA

Roger Lacy and William W. Winternitz. Department of Internal Medicine, College of Community Health Sciences, University of Alabama, University, Alabama 35486.

The authors examined the records of admissions for alcoholism to Druid City Hospital (the regional referral center for West Alabama) by a group of internists between November 1, 1979 and November 1, 1982 to document the presence of illicit alcohol ("moonshine") consumption by these patients. This uncontrolled study indicates that the population at highest risk in Tuscaloosa County is predominantly middle-aged, black, and male. Cases with a history of moonshine consumption were not always investigated for the presence of lead intoxication. In several instances investigation for lead toxicity with positive results was not followed by chelation therapy. Finally, we reviewed the literature on lead intoxication secondary to illicit alcohol consumption and compared the laboratory and clinical findings previously reported with the findings in our patients with lead intoxication.

POLYCATION EFFECTS ON Na^+-D-GLUCOSE TRANSPORT IN RENAL MEMBRANES. Ada Elgavish , Dennis J. Pillion, and Elias Meezan[*]. Dept. of Pharmacology, University of Alabama in Birmingham, Birmingham, AL 35294 and Perry W. Cole[*], VAMC, Tucson, AZ 85723.

High levels of polyamines in the blood serum and urine and light-chain proteinuria are characteristic features of certain neoplastic diseases. The presence of these polycationic species in the urine has been associated with abnormal kidney function. We have studied the effect of incubation in vitro (60 min, 37°C) with various polycations on Na^+-D-glucose co-transport in isolated rabbit renal brush border (BB) membranes.

a) Polypeptides

Lysozyme (μM)		K-light chain (Patient A) (μM)	
0	100	0	100
187.8 ± 7	156.3 ± 3.5	216.8 ± 3.9	93.3. ± 0.5

D-glucose transport (1 min) (pmoles/mg protein)

b) Polyamines

Control	Spermine (50 μM)	Spermidine (50 μM)	Putrescine (50 μM)
137.3 ± 9.5	206.6 ± 9.5	205.8 ± 8.1	221.7 ± 41.6

D-glucose transport (30 sec) (pmoles/mg protein)

Conclusions: (1) Polyamines and light-chain immunoglobulins affect the transport properties of the renal proximal tubule BB. (2) Although both chemical species are polycations at physiological pH, the polyamines stimulate and the polypeptides inhibit the Na^+-D-glucose co-transport. These findings suggest that the mechanisms of action of these polycations are not solely due to their charge.

AN UNUSUAL COMPLICATION OF PICA #73

Stephen Cope and Beverley Phillipson. Dept. of Internal Medicine, College of Community Health Sciences, Univ. of AL 35486.

Pica, the craving for strange foods, is seen in a variety of settings and produces some well known clinical entities. This case report of a forty-four year old black female serves to illustrate both the usual and unusual associations of pica and clinical medicine. This patient had a greater than twenty-five year history of eating approximately nine to twelve ounces per week of "sour dirt." She also had a history of consuming laundry starch in lesser but not quantified amounts. This case serves to illustrate the common association of iron deficiency anemia and pica, but also serves as an illustration of a previously unreported physical finding due to pica, namely the attrition and abrasion of her teeth due to the chronic dietary insult imposed by her strange eating behaviors. This case further serves as a reminder to physicians, dentists, and other health care personnel of the importance of performing a detailed history and physical examination. The association of pica and its clinical manifestations should be looked for as a means to treat correctable disease.

Abstracts

SEM OF HUMAN FETAL SKIN

W. H. Wilborn, B. M. Hyde, and L. F. Montes. Electron Microscopy Center and Department of Anatomy, University of South Alabama, Mobile, AL 36688

Prior to birth, human skin is surrounded by germ-free amniotic fluid, maintained at constant temperature and pressure, protected from light and against friction, and buffered from shocks. The goal of this investigation is to show by scanning electron microscopy (SEM) how the skin develops so that the newborn can survive outside the uterus. The material for study consisted of 3 embryos (6 to 7 weeks) and 20 fetuses of different gestational ages that were obtained over a period of several years at times when it was necessary to perform hysterectomies for medical reasons. At 7 weeks, the epidermis has an outer layer of cells, the periderm, and an inner layer of cells, the stratum basale. A stratum intermedium is added in the 3rd month. The periderm protects the underlying layers of cells and serves in the exchange of substances between fetus and amniotic fluid. It is shed in the 26th week concomitantly with the appearance of lanugo hairs and the stratum corneum. Epithelial germs of the epidermis extend into the dermis and give rise to the cutaneous appendages (hairs and glands) during the 3rd, 4th, and 5th months. Eccrine sweat glands and sebaceous glands are well-developed and active before birth. The dermis consists of mesenchymal cells, ground substance, and plexuses of blood vessels before the 3rd month. Reticular fibers appear in the 3rd month when the mesenchymal cells become active fibroblasts. Reticular fibers mature to become bundles of collagenous fibers. Elastic fibers do not appear until the 6th month. By the 28th week, fetal skin has acquired the anatomical features that permit survival outside the uterus.

LIFE SATISFACTION AS REPORTED BY BLACK RETIREES

Delois H. Skipwith, University of Alabama School of Nursing, University of Alabama in Birmingham, Birmingham, Alabama 35294

This study investigated the determinants of life satisfaction and dissatisfaction during retirement in black retirees. The differences in the determinants of satisfaction and dissatisfaction according to marital status, gender, income, health status, and length of retirement were tested at the .05 level of significance. An interview schedule and the Life Satisfaction Index Z Scale (LSI-Z) were used. The sample consisted of 50 black retirees, age 60 to 71 years, who had voluntarily retired at least two years prior to the study. The findings indicated a group of healthy, married, female educators with income in the $500 to $1000 category. Interpersonal relationships, organizational activities and freedom of schedule and time were the primary sources of satisfaction for this group. Most of the respondents did not identify sources of dissatisfaction; however, economic conditions, health, and emotional concerns were cited most frequently by the respondents who identified sources of dissatisfaction. There was a difference in the determinants of dissatisfaction and marital status and length of retirement. They were moderately satisfied with life as reflected by a score of 21.4 on the LSI-Z.

SEM OF RABBIT SPERM IN UTERO

B. M. Hyde and W. H. Wilborn.   Electron Microscopy Center and
Department of Anatomy, University of South Alabama, Mobile, AL 36688

The purpose of this study is to show by scanning electron microscopy
(SEM) the changes in rabbit sperm while they are residents in the
female reproductive tract.   Prior studies have made only limited use
of SEM for this purpose.   Twelve adult New Zealand White Female
rabbits were used.   Each female was placed with an adult male rabbit
9, 15, or 24 h before sacrifice.   The male was removed 1 h after the
initial mating.   Reproductive tracts of the females were removed and
prepared by conventional methods for SEM.   Millions of sperm were
present in the reproductive tract of each rabbit.   Most sperm were
found in gland lumina where they were destined to degenerate.   The
majority of the remaining sperm showed signs of degeneration at 9 h
postcoitum.   The acrosomal membrane complex, the portion of the sperm
head necessary for penetration of the ovum, was more susceptible to
fragmentation and detachment than any other portion of the sperm.
Separation of the head and tail in the neck region was a common alter-
ation which increased in frequency with time postcoitum.   The post-
acrosomal region of the head did not show significant physiological
degeneration even at 24 h postcoitum.   This can be explained by the
fact that the postacrosomal membrane, in contrast to those of the
acrosome and neck, is firmly supported by underlying structures and is,
therefore, less vulnerable to fragmentation and detachment.   At 24 h
postcoitum some sperm were free of anatomical alterations and appar-
ently capable of fertilization.   It was concluded that SEM is suited
for evaluating the fate of sperm in the female reproductive tract.

SEVERE THROMBOCYTOPENIA ASSOCIATED WITH SARCOIDOSIS

Neil Moss and Jerry McKnight.   Department of Internal Medicine.   College
of Community Health Sciences, University of Alabama, University, AL 35486

Severe thrombocytopenia is a rare manifestation of sarcoidosis.
Following is a case report of clinical sarcoid associated with extreme
thrombocytopenia.

17 y.o. B.F. was referred because of bleeding from the mouth and nose
with multiple petachiae, after a three month history of shortness of
breath and intermittent chest pain.   Platelet count on admission was 1000
per cubic mm (with no abnormalities in secondary hemostasis and adequate
bone marrow megakaryocytes).   Chest roentgenogram showed bilateral basilar
infiltrates and hilar adenopathy.   Laboratory findings included elevated
angiotensin converting enzyme without hypercalcemia, hypercalciuria or
hyperglobulinemia.   The patient was anergic to locally applied antigens.
First degree heart block was present.   The patient was treated with an
equivalent of 80 mg prednisone per day for three days (with a slight re-
sponse).   Prednisone was then increased to 200 mg per day and the platelet
count rose rapidly to normal and has remained stable as prednisone has
been tapered to 10 mg per day.   Pulmonary infilterates have diminished but
are still present after two months.

TEENAGE SMOKING: RISK FACTORS AND BIOFEEDBACK INTERVENTION

Jeanette Lancaster, David Naftel, and Kathy Jo Ellison. School of Nursing and Dept. of Biostatistics, UAB, Birmingham, AL 35294

Factors associated with teenage smoking and the influence of providing information about the immediate physiological effects of smoking on smoking habits were investigated in tenth graders of four Jefferson County high schools. Two schools designated as control schools and two as experimental schools were matched for location (urban/rural), size and current smoking regulations. Pre and post questionnaires on smoking habits were administered in the tenth grade physical education classes at an eight week interval. Following the pretest in the experimental group, class was conducted by the investigators to allow students to utilize the biofeedback machines and provide a program on the effects of smoking. Eleventh grade student assistants operated the biofeedback equipment which provided information to each subject on pulse, hand temperature, rate of hand tremor, and amount of carbon monoxide in exhaled air. Subjects who were smokers were tested before and after smoking a cigarette. Pretest questionnaires from 620 tenth grade students indicated 16.4% classified themselves as smokers. A multivariate assessment of factors associated with smoking indicated a student most likely to be a smoker is white, makes poor grades, is not in the academic or general curricula, has parents who smoke and his older siblings, if he has any, smoke. In terms of altering smoking habits, the net effect of this study was zero with a net change of +4 in the frequency of smoking of the subjects in both the control and experimental groups.

SKELETAL MUSCLE RELAXANTS AND BLADDER SMOOTH MUSCLE

Farris M. Ayyat, Keith V. Kuhlemeier and L. Keith Lloyd. Urology Rehabilitation and Research Center, University of Alabama in Birmingham, Birmingham, AL 35294

Baclofen, dantrolene sodium and diazepam are skeletal muscle relaxants widely used to allievate skeletal muscle spasms of various neuromuscular disorders. Bladder smooth muscle hyper- or hypo-tonus is a common complication of these disorders. This study was conducted to determine the effect of skeletal muscle relaxants on rat, rabbit and human smooth muscle contractions in vitro. Contractile strength was measured before and after 30-70 minute incubations with baclofen (4 mcg/ml), dantrolene sodium (4 mcg/ml) or diazepam (0.25 to 1.0 mcg/ml). Neither baclofen nor dantrolene sodium had any effect ($P > 0.1$) on rat, rabbit or human bladder muscle. Diazepam potentiated both electrically-induced (115% of pre-drug contractile strength, $P < 0.05$) and acetylcholine (Ach)-induced (122% of pre-drug contractile strength, $P < 0.01$) contractions in rat but not rabbit or human bladder muscle. While diazepam is thought to exert its effects on skeletal muscle through CNS inhibition, these resuslts suggest that diazepam may directly effect bladder muscle of some species.

SEM OF EPITHELIAL OUTGROWTHS TREATED WITH A PHORBOL ESTER

Baldev B. Singh and George S. Schuster, Department of Oral Pathology
and Oral Biology, Medical College of Georgia, Augusta, GA   30912

Previous in vivo studies from our laboratories have shown that croton
oil enhanced epithelial cell proliferation and altered differentiation
of hamster cheek pouch epithelium. The objective of the current inves-
tigation was to examine the effect of 12-0-tetradecanoly-phorbol-13
acetate (TPA), an active constituent of croton oil, on the epithelial
outgrowths in an in vitro system. For this purpose hamster cheek pouch
explants were grown for a period of 10 days. After 7 days in culture
the explants were treated with 1.6×10^{-8} M TPA for 4 hours. The cul-
tures were examined histologically following treatment by colcemid for
18 hours. Other specimen were studied by SEM. Light microscopic obser-
vations showed enhanced mitotic activity and an increased growth size of
the TPA treated epithelial outgrowths ($2.25mm^2$) as compared to $1.55mm^2$
for the controls. SEM of the control culture exhibited cells generally
similar in shape and size. Many of these cells were polygonal in shape
and contained medium to large sized microvilli. The experimental cul-
tures showed marked variability in the size and shape of the cells.
These included polygonal cells with sharp angular forms, round smooth
spheroids and some depicting fibroblast-like configurations. The micro-
villi varied in size and thickness and occasionally traversed long
spatial lengths to interconnect with cells at a considerable distance.
A host of bleb formations were also noticed. These observations in-
dicate that TPA enhanced epithelial cells proliferation and apparently
induced clustering cells. Supported by NIDR Grant DE06239.

TECHNIQUES TO MEASURE INTRACELLULAR POTENTIALS OF OXYNTIC CELLS

Richard L. Shoemaker, Department of Physiology & Biophysics,
University of Alabama in Birmingham, Birmingham, AL   35294

The objective of this work was to develop a method to measure the
intracellular potential of oxyntic cells in the gastric mucosa,
using bullfrog stomachs in vitro. These measurements are very
difficult to obtain because of the complexity of the gastric mucosa,
i.e. four or more cell types at different depths; thus, the electro-
physiological properties of the oxyntic cells has not been com-
pletely determined. The oxyntic cells are not visible because they
are located 75 to 250 μ from the surface or lumen and they are
located around the walls of gastric tubules; four techniques were
tried to improve visualization so that these cells could be punc-
tured with microelectrodes: (1) small segments of the mucosa were
mounted in agar blocks and sliced with a vibratome (50 to 100 μ
sections), (2) a razor blade was used to slice thin sections, (3)
the submucosa was removed and the oxyntic cells were punctured from
the serosal side (tissue mounted in a chamber), (4) hand dissection
to obtain individual isolated oxyntic glands (glands held by micro-
pipettes for cell punctures). The third procedure was more
successful and reproducible. A.O. dye was added to the thin slices
and fluorescence was observed in the gastric tubules.

Abstracts

EFFECT OF CPZ ON SCE FREQUENCY IN CULTURED LYMPHOCYTES

Jack E. Watson, Dept. of Zoology-Entomology, Auburn Univ., Auburn, AL
36849. Velma B. Richardson, Dept. of Biology, Tuskegee Institute,
Tuskegee Inst., AL 36088.

Cultures derived from two donors were treated, with ten-fold
increases in the concentration of chlorpromazine hydrochloride (CPZ)
ranging from 0.05 to 5.0 µg/ml, and cytogenetically analyzed for sister
chromatid exchange (SCE) induction. Compared with the untreated
controls a small but significant increase in the SCE rate was observed
at the 0.5 µg/ml dose level in cells derived from Donor 1. Cells
derived from Donor 2 did not exhibit SCE rates that differed signifi-
cantly from untreated controls. An increase in SCE rates that was
dose-dependent was observed in cultures derived from both donors up to
0.5 µg/ml dose level. Cultures exposed to higher concentrations of
CPZ showed reduced SCE rates and suppressed mitotic indices. Similar
responses were observed in the number and position of SCE's per
chromosome in control and treated cultures. Of the observed SCE's
over 82 percent occurred as single exchange events with an interstitial
pattern of distribution. This study shows that although SCE induction
following CPZ treatment shows different total numbers of SCES between
the two donors, the responses are not associated with a concomitant
increase in the number of multiple SCE's per chromosome.

THE INFLUENCE OF SALT IN RENOVASCULAR HYPERTENSION

Cynthia A. Jackson and L.G. Navar, Dept of Physiology and Biophysics,
727 CDLD, Univ. Station, Univ. of Alabama Med. Ctr., B'ham, AL 35294

Experiments were conducted on Two-Kidney, One Clip Goldblatt
Hypertensive rats to assess the effects of salt intake on systolic
blood pressure and its influence on renal function. A significant
difference in the blood pressure of the clipped rats (n=21, BP=147
+ 7 mm Hg) and the nonclipped rats (n=16, BP=119 + 2 mm Hg) could be
detected on day ten. However, the addition of 0.9% sodium chloride
solution did not significantly alter the blood pressure within the
hypertensive or normotensive rats. Seven days after the animals
were clipped, an elevated blood pressure of 140 mm Hg was observed
in the water-drinking clipped rats. Three days later, an elevated
blood pressure of 140 mm Hg was observed in the saline-drinking
clipped rats. The addition of salt did significantly suppress the
PRA from 4.01 ng/ml/h in the water-drinking clipped rats to 1.82
ng/ml/h in the saline-drinking clipped rats. The kidney renin con-
tent in the saline-drinking clipped rats was also suppressed when
compared with the water-drinking clipped rats. Bilateral renal func-
tion (urine flow, GFR, and sodium excretion) of the water-drinking
clipped rats was less when compared to the control normotensive rats.
However, the administration of saline to the clipped rats generally
improved the bilateral renal function. These observations support
the concept that elevated blood pressure may be maintained with de-
creased PRA; thus insinuating an involvement of an additional mecha-
nism for maintaining elevated blood pressure in this model.

Abstracts

INVESTIGATION OF THE PSYCHOMETRIC PROPERTIES OF THE NURSING DILEMMA TEST

BARBARA J. REID, SCHOOL OF NURSING, UAH, HUNTSVILLE, AL 35899

A majority of nurse investigators prefer to accept the reliability and validity of an instrument rather than build such studies into their investigations. An evolving area of research interest is studying the ethical dilemmas that practicing nurses face daily in their work setting. The need to know more about the thinking processes of nurses making ethical decisions is vital, but a lack of instruments prevented us from studying this aspect of clinical practice. Thus, when and instrument was developed by Dr. Patricia Crisham that purported to measure ethical decision making by nurses, many investigators became interested in the subject and wished to use the instrument. Therefore, it became imperative to do psychometric studies on the Nursing Dilemma Test to demonstrate estimates of its reliability and validity.

A non-probability sample of 91 registered nurses from North Alabama hospitals was used. Data analyses used were Cronbach's Alpha Principle Axis Factoring with Normalized Varimax rotation and Canonical Correlation.

Results indicate the estimated alpha coefficients for each level of moral thinking to be low; 2 per cent of the interitem correlations were $\geq$ .30, therefore factor analysis was not attempted; and the canonical correlation showed every level of thinking but nursing principled thinking to be highly related to the items measuring that particular level. More psychometric studies are called for with at least five subjects per item of the instrument.

SEM OF HUMAN ADULT SKIN

W. H. Wilborn, B. M. Hyde, and L. F. Montes. Electron Microscopy Center and Department of Anatomy, University of South Alabama, Mobile, AL 36688

Transmission electron microscopy has been used for most studies on the ultrastructure of normal adult human skin. We have found scanning electron microscopy (SEM) to be particularly suitable for investigating the complex architecture of normal and abnormal skin. SEM makes it possible to view three-dimensionally the structure of large cutaneous specimens at magnifications ranging from 10X to 50,000X. SEM shows that the stratum corneum of much of the skin surface contains bacteria and yeasts in pockets of scales where they cannot be easily removed by washing. Sebum from continuously-secreting sebaceous glands serves as fuel for many types of microorganisms. Sweat of eccrine glands is antimicrobial. Consequently, sweat pores at the surface are usually free of microorganisms. In contrast, the secretion of apocrine sweat glands in the axillae contains the microprocesses of cell apices and tends to promote the growth of microorganisms. Debris and micro-organisms accumulate in the depressions where hairs project onto the skin surface. Scales are constantly being desquamated at the free surface. This process appears to increase with age. Further study of normal skin by SEM is an essential prerequisite for the recognition and characterization of each of the more than 2,000 skin disorders.

A SPORTS MEDICINE PROFILE OF AN ALABAMA HIGH SCHOOL FOOTBALL TEAM
M. Culpepper*, K. Francis#, L. Sampson #. Division of * Orthopaedic
Surgery and # Physical Therapy, Univ. of Ala. in Birmingham,
Birmingham, AL. 35294

Anthropometric and injury data were collected from an Alabama 2A
class high school football team during the 1982 season to observe the
effects of in season competition and to develop an injury data profile.
The season consisted of 3 wks. pre-season practice and 11 wks. of
competition. The following data were collected: n=34, body wt ($\bar{x}$ =
152.5 ± 5.1 lbs), % body fat ($\bar{x}$ = 9.4 ± .6). Pre-season 2 a day
practices showed a mean AM wt. loss of 2.8 ± .5 lbs and a PM wt. loss
of 2.9 ± .2 lbs. Adequate between practice rehydration was evident.
There was no relationship between humidity and wt. loss (R=.32). In
season competition resulted in 53 injuries (23 game, 30 practice).
These included: contusions-14, strains-12, sprains-9, heat illness-4,
concussions-4, fractures-3, other-5. Common body areas affected were
head/neck-9, shoulder-6, groin-6, knee-5, lower leg-4, wrist-3,
ankle-3, trunk-3, hip-3, hand/fingers-2, other-10. Player position
injuries included runningbacks-17, defensive linemen-14, defensive
backs-5, offensive linemen-5, quarterbacks-5, wide receivers-4, line-
backers-3. 30 injuries resulted in loss time to practice or game; 11
players missed a combined 22 games, and 3 game injuries required
transfer to a hospital. 8 non-football medical conditions included 2
contusions (motorcycle accident), 2 infections (ear, sinus), 2 GI
problems and 1 skin rash. These data indicate that injury patterns of
individual schools do not necessarily follow established injury pro-
files and suggest the need for qualified personnel to handle such
injuries.

SEM OF THE REPRODUCTIVE TRACT OF THE APPLE SNAIL, POMACEA PALUDOSA.

Patricia E. Vermeire, Electron Microscopy Center, University of South
Alabama, Mobile, AL 36688

The albumen gland of Pomacea paludosa, a prosobranch gastropod,
contains two main ducts. The albumen gland duct consists of a single
layer of secretory and non-secretory cells. The surface of the non-
secretory cells is covered with cilia. Microvilli are associated with
the luminal edges of the secretory cells. Globules of secretory
products appear at the cell surfaces. The duct of the capsule gland
coils through the albumen gland and is composed of two opposing faces,
each with two layers of cells. The upper layer consists of ciliated,
non-secretory cells and the microvilli-covered necks of the goblet-
shaped secretory cells. The bases of the secretory cells comprise the
lower layer of cells. The anatomy of the reproductive tract is similar
to other descriptions for the genus, but differs slightly from other
members of the prosobranch group. The duct system within the albumen
gland functions to store large numbers of eggs before deposition and
to coat the eggs with several egg-coats, including the calcified shell.
The ciliated surfaces facilitate the movement of eggs and secretory
products. Differences in epithelial folding correlates with cyto-
chemistry and ultrastructure, reported elsewhere (Vermeire & Hinsch,
1983).

ADMINISTRATORS' RECOMMENDATIONS FOR NURSING EDUCATION

Beverly M. Henry.   School of Nursing, Univ. of Ala. in Birmingham, Alabama   35294

Nursing administrators (NA's) in hospitals play a significant part in the quality of patient cost and care. But the recommendations of hospital and nursing administrators for nursing administration education are little examined. The purpose of this study was to compare nursing and hospital administrators' (HA's) recommendations for the knowledges and skills necessary for nursing administrators. From a random sample of 1000 hospital and 1000 nurse administrators in 14 southeastern states' hospitals, 208 and 206 administrators responded to a self-administered mailed questionnaire. When asked to agree (5) or disagree (1) on a five-point scale about whether NA's should have knowledge in 8 management categories, HA's and NA's respectively agreed most strongly that nurses should be knowledgeable about human resources (4.3, 4.5) and patient management (4.3, 4.3). The remaining agreement scores were interdepartmental relationships - 4.1, 4.1; operations manageme-t - 4.1, 4.2; policy - 3.9, 4.4; finance - 3.6, 4.0; research - 3.8, 4.0; and physicians - 3.3, 3.8. For the 46 items, six scores were significantly different for the HA's and NA's (2-Tail T) at the .001 level. The findings suggest that knowledge of nursing care and human resource development be part of NA's education and that administration, policy, and law also be emphasized. The data for this study were collected by Drucilla Mantle with funding from the W. K. Kellogg Foundation and the Division of Nursing, DHHS.

RENAL FUNCTION CHANGES AFTER SPINAL CORD INJURY

K.V. Kuhlemeier, A.B. McEachran, L.K. Lloyd, P.F. Fine, and S.L. Stover. Urology Rehabilitation and Research Center, University of Alabama in Birmingham, Birmingham, AL. 35294.

Computer-assisted renal scintigraphy was performed on 160 acute, spinal cord injured patients, 240 chronic spinal cord injured patients and 287 non-spinal injured control subjects. Concurrently, measurements of global and differential effective renal plasma flow (ERPF), time of maximum activity in each kidney and the ratio of maximum counts to the counts at 27 minutes post injection over each kidney were made. The time of peak activity over the kidney and differential function were not significantly affected by age, gender, or spinal cord status. Global and differential ERPF were significantly affected by all of these factors. Both plasma flow measures were higher for males than for females. ERPF declined steadily after early adulthood and, except for the youngest and oldest patients, values were lower for acute spinal cord injured patients than for normal controls. The ratio of peak to 27 minute counts was significantly affected by age and spinal cord status but not by sex. Follow-up scintigrams at 1 to 3 years post-injury showed no significant changes due to time since injury on any parameter studied. Lower limits of normal scintigraphic parameters will be given for evaluation of renal status in intact or spinal cord injured persons.

Abstracts

SEXUAL IRRESPONSIBILITY: A STUDY OF PRACTICES AND KNOWLEDGE AMONG 510 UNIVERSITY UNDERGRADUATES

Robert S. Northrup, M.D., James D. Leeper, Ph.D., and Susan H. Hoeppner, College of Community Health Sciences, University of Alabama at Tuscaloosa, University, Alabama 35486

Unmarried pre-freshmen, freshmen and seniors (total 510) at a large state university completed a health questionnaire which examined sexual attitudes practices, and knowledge. University life and church involvement had strong and opposite influences on outcome. Students living off campus had more liberal attitudes and practices. Thirty-six percent of pre-freshmen, 46% of freshmen, but 60% of seniors had had sexual intercourse in the past year. Of regular church goers, only 41% had had intercourse in the past year, while 70% of students not attending church regularly had. Sixty-three percent living off campus were active, while 35 to 41% of students living in fraternities or sororities, University housing, or at home were active. Many students did not use effective contraceptives, and were embarassed to discuss contraception with their sexual partners. Pre-freshmen in particular were extremely deficient in knowledge about contraception and veneral disease, but even seniors only received a mean of 41 points from 100 possible regarding sexual knowledge. Parents of 33% of students have never expressed to their children their views of premarital sex. It may be concluded that, in a climate of increasing sexual liberality, many students lack the knowledge and have attitudes which lead to sexual irresponsibility.

CLONIDINE OVERDOSE IN 21 MONTH OLD

Frank Dozier and Neil Moss. Department of Internal Medicine, College of Community Health Sciences, University of Alabama, University, AL 35486.

21 month old black female, at approximately 5:30 pm on 10/13/82, was found to have taken eighteen, 0.2 mg clonidine (Catapres) tablets; total dose=3.6 mg. She was taken to an emergency room and her stomach was lavaged. Pill fragments were recovered. She was given charcoal and magnesium sulfate. Initially combative, she soon suffered respiratory arrest and was immediately intubated. Initial hypotension was followed by hypertension (184/130). She was taken to Druid City Hospital where BP was 156-160/110-110. Narcan was given without effect. Phentolamine 0.5 mg IV, given twice, decreased systolic pressure to 100. The patient was without spontaneous respiration and somnolent, but responsive to deep tactile stimulation. BP was controlled on phentolamine 0.5 mg to 1 mg per hour by continuous IV infusion. Fourteen hours after the clonidine ingestion, the patient was alert and eating. Phentolamine was discontinued. Approximately 55 hours after overdose, her BP increased to 156/86. She was again started on IV phentolamine, without effect. Sodium nitroprusside, one microgram per kilogram, was required for BP control. On 10/27, nitroprusside drip was discontinued and BP remained physiologic. She was discharged on 11/1/82, normotensive and was healthy and without complications two weeks after discharge. The pathophysiology of these responses will be discussed.

SOCIAL COGNITION, MOTIVATION, AND COMMUNICATIVE COMPETENCE

Amanda W. Borden, Dept. of Communication Studies, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

Previous research has suggested that certain social-cognitive developments underlie the development of communication skills. The constructivist/cognitive-developmental theoretical perspective posits a series of axes along which social-cognitive developments occur: egocentrism-perspectivism; globality-differentiation; diffusion-integration; concreteness-abstractness; and rigidity-flexibility. Research has shown that development along these axes is a necessary but not sufficient condition for the development of communicative competence. In addition, the motivational factors underlying interpersonal values, empathy, and Machiavellianism, in conjunction with requisite social-cognitive developments, affect levels of communicative competence. A study of 126 subjects revealed that those high in empathy and interpersonal values produced significantly higher-level interpersonal appeals than did those low on these measures. In persuasive communication, low Machiavellians offered significantly more persuadee-oriented justification for action than did high Machiavellians. In addition, there was a significant interaction between social cognition and interpersonal values, indicating that interpersonal communicative performance depends upon both social cognition and interpersonal motivation. A follow-up study of 55 subjects further supported the relationship of low Machiavellianism to persuasive communicative competence.

CALCIUM DEPENDENT PROTEASES IN HUMAN NEUTROPHILS

Janet L. Legendre and Harold P. Jones, Department of Biochemistry, University of South Alabama, Mobile, AL 36688

Extracts of human polymorphonuclear leukocytes have been found to contain calcium-dependent proteases which are active in the neutral pH range. These proteases are normally active between pH 7.2 and 7.8 and are stimulated by the addition of exogenous calcium. Maximal stimulation of the proteases occurs at a free calcium concentration of 190 μM and half-maximal stimulation occurs at 91 μM free calcium. Calcium-dependent proteolysis is strongly inhibited by aprotinin and PMSF, more weakly inhibited by antipain, leupeptin and phenanthroline, and insensitive to sulfhydryl reagents. Gel filtration profiles reveal the presence of two peaks of calcium-dependent proteolytic activity with the major and minor peaks having apparent molecular weights of 74,100 and 68,000, respectively. Subcellular fractionation of the neutrophil reveals a cytoplasmic localization for the calcium-dependent proteases. Attempts to activate the protease with calmodulin or to inhibit it with calmodulin antagonists were unsuccessful.

REPRODUCTIVE IMPAIRMENT AFTER IN UTERO EXPOSURE TO URETHANE

Janice W. Roberts, and C.P. Dagg, Dept. of Biology, Univ. Alabama in Birmingham, Birmingham, AL 35216

The purpose of this investigation was to determine the effects of prenatal exposure to urethane on subsequent reproductive potential of the offspring. The dose of urethane (1mg/gm BW) was nonteratogenic and nonlethal to BALB/c mouse embryos. Twelve females, prenatally exposed to urethane, and 16 controls were test-mated beginning at 60 days of age. In the urethane-treated females 7 of 12 were fertile, whereas 16 of 16 controls were fertile. However, the fertile urethane-treated females produced fewer litters and fewer offspring per litter than did the controls. Reproductive performance of the controls remained constant throughout the test period, but reproductive performance of treated females was initially low and declined throughout the test period. Ten urethane-treated males and 18 controls were test-mated. Four of the 10 treated males were fertile as compared with 17 of 18 controls. Although fewer of the urethane-treated males were fertile, those that were fertile impregnated as many females as did controls. Postnatal body weight was not affected by prenatal exposure to urethane, however, the gonad weights were markedly reduced. The histological appearance of the gonads correlated with fertility or sterility: gonads from fertile animals showed numerous germ cells whereas gonads from sterile animals showed few, if any, germ cells. Therefore, it has been demonstrated that prenatal exposure to a nonteratogenic, nonlethal dose of urethane resulted in serious impairment of postnatal reproductive performance in BALB/c mice.

THE QUANTITATION OF XANTHURENIC ACID IN THE SERUM OF NORMAL AND VITAMIN B_6-DEFICIENT RABBITS

Shirley Williams, John A. Monti, Larry R. Boots, and Phillip E. Cornwell, Dept. of Ob/GYN, UAB, University Station, Birmingham, AL 35294.

Vitamin B_6 deficiency results in increased urinary excretion of xanthurenic acid (XA) in the rabbit and several other species. However, until now, circulating serum levels of xanthurenic acid have been unknown due to insufficient sensitivity of available assays. Xanthurenic acid has been quantitated in the serum of normal and vitamin B_6-deficient rabbits using a gradient, reversed-phase high performance liquid chromatography procedure. Characteristics of this assay included a range of 3.9 to 1000 ng with an average CV of 20.8%, an average recovery of 80.8%, a serum requirement of 1-2 ml and a sensitivity in the low nanogram range. The vitamin B_6 nutritional status of the rabbits was determined by measuring the activity of aspartate aminotransferase with and without exogenous pyridoxal-PO_4. The resulting activity coefficients (A/C) indicated a B_6-deficient state when greater than 2.0. Six normal rabbits with a mean body weight of 3.64 kg and an average A/C of 1.14, had a mean of 141 ng XA per ml serum. Three vitamin B_6-deficient rabbits with an average body weight of 2.8 kg and an average A/C of 2.4, had a mean of 2275 ng XA per ml serum, a 16-fold increase.

EVIDENCE FOR MULTIPLE CHLORPROMAZINE BINDING SITES IN HUMAN PLATELETS

Gary A. Piazza and Robert W. Wallace*. Department of Pharmacology, The University of Alabama in Birmingham, Birmingham, AL 35294

Phenothiazines bind to calmodulin and inhibit its ability to stimulate Ca^{2+}-dependent cellular reactions. This property has been utilized in numerous investigations to decipher the role of calmodulin in intact biological systems. In platelets, phenothiazines inhibit shape change, aggregation, and secretion. To determine if these effects are the result of direct action of the drug upon calmodulin, we have utilized the irreversible binding of [^{3}H]-chlorpromazine (CPZ) upon photoactivation to determine the sites of interaction of CPZ in human platelets. Analysis by SDS-gel electrophoresis of either whole platelets or platelet cytosol revealed a major peak of CPZ at the 43K region of the gel corresponding to platelet actin. Binding of CPZ to this region of the gel was increased approximately 25% in the presence of Ca^{2+}. Cytochalasin D, which binds to actin with high affinity, displaced 45% of the CPZ at the 43K position when present at a concentration equal to CPZ. There was no peak of CPZ at the position of platelet calmodulin. However, this was likely due to the detection limits of our system since a CPZ-calmodulin complex was observed upon addition of exogenous calmodulin. These data suggest that in addition to calmodulin, actin is a major binding site for CPZ in platelets. It remains to be determined whether or not the binding of CPZ to actin plays a role in the inhibitory effect of the drug on the platelet reaction sequence.

ASSESSMENT OF ANTIVIRAL EFFECTS OF NONNEUTRALIZING MONOCLONAL ANTIBODIES IN HSV-1 INFECTED MICE

James Rector, John Oakes, and Robert Lausch. Dept. of Microbiology, Universi of South Alabama, Mobile, Alabama 36688.

Recent studies have shown that nonneutralizing monoclonal antibodies reactive with HSV-1 glycoproteins can mediate recovery from ocular infection in mice (Infect. Immun. 38: 168, 1982). The failure of monoclonal antibodies to neutralize the virus in vitro raised the possibility that antibody-infected cell interaction in vivo is the primary mechanism of action of these antibodies. In order to further evaluate this possibility, nonneutralizing monoclonal antibodies produced against the KOS or 14012 strains of HSV-1 were tested for their ability to react with virus-infected cells but not purified virions in an ELISA assay. One monoclonal antibody, designated 35S and specific for gA/B, reacted with KOS or 14012 infected cells and with 14012 purified virions. However, binding of 35S to purified KOS virions was not detected by ELISA or by velocity sedimentation analysis of antibody-virus mixtures. Passive transfer of 35S twenty-four hours after corneal infection resulted in significant protection ($p<0.01$) against KOS infection when administered 4 h p.i., but was ineffective when administered 1 h before infection. These results show that 35S requires infected cells in order to mediate protection against corneal infection with HSV-1 (KOS) and provides positive evidence for nonneutralizing monoclonal antibody acting on infected cells in vivo as their primary mechanism of action.

Abstracts

SEM OF PIGMENTED NEVI

W. H. Wilborn, B. M. Hyde, and L. F. Montes. Electron Microscopy
Center and Department of Anatomy, University of South Alabama,
Mobile, AL 36688

Pigmented nevi (common moles) usually affect 100% of the population.
These malformations of the skin have not been previously studied by
scanning electron microscopy (SEM). Our findings are based on the
study of 10 junctional nevi, 20 intradermal nevi, and 12 compound nevi,
which were removed from 8 male and 16 female patients who ranged in age
from 26 to 64 years. Each specimen was bisected and one part was
processed for correlative SEM and TEM, and the other portion for
histopathology. Pigmented nevi contain an abundance of pigment-laden
melanocytes, called nevus cells, which can be located in the epidermis
(junctional nevus), in both the epidermis and dermis (compound nevus),
or only in the dermis (intradermal nevus). Most nevus cells in the
epidermis and dermis are located in nests; the remaining occur as
bands, strands, or as single cells. Individual nevus cells and aggre-
gates of nevus cells enter the dermis from the epidermis by the so-
called "dropping-off" process ("Abtropfung" or more correctly,
abtropfen). The lesions have deep invaginations of the keratinized
free surface, crisscrossing creases, and a preponderance of follicular
openings with multiple hairs. Three types of nevus cells can be rec-
ognized (designated A, B, and C), each of which has distinctive
features. These features can be used to diagnose nevus cell lesions
by SEM and to gain an insight into their histogenesis.

SEM OF THE BASAL CELL CARCINOMA

W. H. Wilborn, B. M. Hyde, and L. F. Montes. Electron Microscopy
Center and Department of Anatomy, University of South Alabama,
Mobile, AL 36688

The basal cell carcinoma (epithelioma) is the most common malignant
lesion of human skin in the elderly. These tumors often develop in
individuals who live in geographical regions with much sunshine, and
most frequently involve the sun exposed areas (face and scalp) of
persons of fair complexion. The material for this study consisted of
24 nodular, 5 superficial, and 3 pigmented basal cell carcinomas.
Scanning electron microscopy (SEM) has not been used previously to
examine these tumors. SEM provided the following new information:
(1) the free surface of the tumor is highly irregular with horn cysts
and hyperkeratotic follicular openings; (2) sebum covers the free sur-
face of the lesion and serves as a fuel for the proliferation of the
microorganisms that are associated with the tumor; (3) fibrin and
leukocytes are present on the free surface; (4) horn cysts arise in
the dermis from the keratinization of islands of tumor cells (dis-
placed basal cells) and are pushed upward to the free surface; and
(5) hair follicles are affected by the tumor, resulting in the forma-
tion of abnormal corkscrew hairs. The presence of lymphocytes on the
free surface of the tumor was interpreted as a positive feature since
tumors encrusted with lymphocytes were undergoing spontaneous
regression.

Abstracts

BEHAVIORAL ASSESSMENT OF INFANTS OF DIABETIC MOTHERS

Ellen B. Buckner, J. Gail Williams, Kathleen G. Nelson, and John F. Huddleston, School of Nursing, Depts. of OB/GYN and Pediatrics, Univ. of Ala. in B'ham., B'ham., AL 35294.

Twenty-one infants of diabetic mothers (IDMs) were examined using the Brazelton Neonatal Behavioral Assessment Scale (BNBAS). Clinical cluster scores were assigned in dimensions of interactive, motoric and organizational processes. Subjects were infants born to diabetic mothers, class B-F, weighing at least 2500 gms. More variability in behaviors was exhibited by the IDMs than has been reported in the literature for full-term infants of low risk mothers. A high incidence of poor performances occurred in the various clusters with 48% of subjects scoring below "average." Maternal hyperglycemia in the third trimester was calculated from daily diaries kept by mothers. There was a significant correlation between the infant's behavioral performance and the fasting mean blood sugar levels over 100 mg% ($r = .5$, $p < .01$). Infants of mothers with high mean fasting blood sugars had poor behavioral scores. Implications for clinical use include: (1) using the BNBAS to identify infants at risk due to poor intrauterine environment, (2) identifying parent-infant pairs at risk due to depressed ability of the newborn to elicit and reinforce positive caretaking activities from its parents, and (3) planning care and follow-up of at risk parent-infant pairs in order to assure optimal environment for the infant's growth and development. Partial support for this project was provided by a grant from the National Institutes of Health, NIH#1 RO1 HD12559 01.

PREDICTION OF KIDNEY DYSFUNCTION AFTER SPINAL CORD INJURY

Keith V. Kuhlemeier, L. Keith Lloyd, Ann B. McEachran, Philip R. Fine and Samuel L. Stover. Urology Rehabilitation and Research Center, University of Alabama in Birmingham, Birmingham, AL 35294

Longitudinal surveillance of the urinary tract is required after spinal cord injury to detect and treat asymptomatic abnormalities. We have assessed multiple variables obtained at the time of routine annual evaluation to determine which of them predicts future development of pyelocaliectasis and to allow earlier evaluation and intervention. Two hundred seventeen patients studied since 1977 had sufficient data for inclusion in the study. Of the 16 variables examined, the presence of kidney stones at any year of evaluation, the presence of bladder diverticuli in year 1, the presence of vesicoureteral reflux in year 1 and a change in effective renal plasma flow were significant in predicting development of pyelocaliectasis. Bladder diverticuli and vesicoureteral reflux are indicators of imbalanced vesicourethral function which would be expected to require therapeutic intervention. A change in effective renal plasma flow as a predictor of significant pyelocaliectasis further underscores the utility of the comprehensive renal scintillation procedures for follow-up evaluation of patients with neurogenic bladder. The presence of any of these variables should prompt appropriate urologic investigation directed toward improving the underlying bladder dysfunction.

Abstracts

MILK YIELD AND HORMONAL PARAMETERS IN EARLY LACTATION

Ellen B. Buckner, School of Nursing, Univ. of Ala. in B'ham., B'ham.,
AL 35294.

The problem of inadequate milk supply is one of the most common
reasons given for early discontinuance of breastfeeding. This research
was undertaken to identify factors which may influence milk production
through alterations in physiological mechanisms. Thirty-two breast-
feeding mothers were seen by the nurse-investigator between two and four
weeks postpartum. Milk yield was calculated as the change in the in-
fant's weight from before to after nursing plus the milk remaining which
could be expressed using an electric breastpump. Hormonal parameters
were determined from maternal pre- and post-nursing serum samples by
radioimmunoassay. The milk yield measured at the single feeding was
significantly correlated with infant weight change since birth (r=.60,
p<.001). The prolactin response to suckling was significantly corre-
lated with milk yield (r=.36, p$\leq$.03). Women who had a postpartum in-
fection had lower prolactin responses. Women who nursed their infant
in the first hour after delivery had higher prolactin responses. The
baseline prolactin level was negatively related to milk yield (r= -.37
p$\leq$.01). This may represent a compensatory system or an inhibitory in-
fluence. Estradiol was elevated in women who reported their infants
sucked poorly. This may document resumption of ovarian function when
sucking stimulus is inadequate. This research was supported by a
Nursing Research Emphasis Grant/Doctoral Programs, 5-R21-NU-00835-02.

ENGINEERING AND COMPUTER SCIENCE

A DIRECTED COMPUTER OPTIMIZATION SCHEME

I. Chen and S. Chen. Computer and Information Sciences Department.
Alabama A&M University, Normal, AL 35762

The Monte Carlo method is applicable to computer optimization using
high speed random generator, searching randomly for a better solution
for each new step. Theoretically, this method can reach the desired
solution as close to the optimum as possible, as long as the
computer time is not limited. This method requires no calculus
optimization or any other numerical optimization background and is
easy to learn and program. However, this method is very inefficient
as far as computer time is concerned. By imposing a direction of
search routine on the Monte Carlo method, this proposed scheme will
direct the random search only in the optimizing direction for each
function variable at each step. Several examples will be presented
to compare with gradient and non-gradient methods in the aspects of
computer time and convergency. This scheme seems to have a virtue
of simplicity and efficiency.

Abstracts

THE MAKING OF ASP: A LANGUAGE DEVELOPMENT FACILITY

John Barrett and Kevin D. Reilly, Dept. of Computer and
Information Sciences, Univ. of Ala. in Birmingham,
Birmingham, AL 35294.

Augmented STAGE2 Processor (ASP) is a language develop-
ment facility designed primarily to serve as a tool in
language feature analysis and design. It represents an
"old" product being modernized and used in a new way. It
is based on STAGE2, a general-purpose macro processor
developed by William Waite in the early 70's. Several
extensions and modifications have been made to STAGE2 in
order to arrive at ASP. The changes include 30 additional
input/output channels, easier file handling capabilities,
five new processor functions, and a new strategy in the
definitional facilities. The changes have allowed us to
modify the role of the processor from batch-oriented to
that of an interactive (and batch) interpreter. The
definitional facilities allow flexibility and extensibil-
ity, e.g. in constructing a tailored language. Several
"kits" which we collectively call Barrel, have been devel-
oped for experimentation including features from languages
such as LISP, ICON, BASIC, C, and ADA. Included in Barrel
is a table processing component oriented towards decision
table entry, translation, and presentation. ASP has also
been used to experiment with such features as functional
programming, logic programming, and relational databases.

TECHNIQUES OF DOCUMENTATION IN SYSTEMS ANALYSIS AND DESIGN

Rishi R. Chowdhury, Systems Analyst, Stockham Valves & Fittings, Inc.,
Birmingham, Alabama 35212

Documentation is inevitable in a successful systems analysis and
design. In this paper, the techniques of documentation is highlighted.

In general, there are two type of software systems - inhouse soft-
ware and purchased software package. In both the cases a user involve-
ment and satisfaction is a key factor. A good systems design always
needs good documentation. First document in System planning, analysis
and design is user needs analysis report. It is further expanded by
the use of modern structured tools-Structure Charts and Data Flow
Diagrams (DFD).

Report Brochure Document and Management Summary are important for
successful design. For purchased software packages, Software Features
Matrix and Software Cost Matrix are helpful. In detailed design, User
Manual, Systems & Programming Manual, Operations Manual and Project
Development Manual are necessary. Project Design Checklist could be
used to keep track of necessary documents. The same checklist could
be used in postimplementation review. These documents make a success-
ful system.

ANTHROPOLOGY

S. T. KIMBALL IN ALABAMA, 1948-1953: A MEMORIAL ROUND TABLE

Margaret Z. Searcy and Asael T. Hansen. Dept. of Anthropology, Univ.
of Ala., University, AL 35486.

Solon T. Kimball, a Harvard Ph.D., came to the University of Ala-
bama from Michigan State, midway in his increasingly distinguished
career. He had impact. One of his first acts was to change the title
of the department he chaired from Sociology to Sociology and Anthro-
pology. New courses were added, the M.A. program strengthened, re-
search emphasized, and staff and graduate students stepped up their
participation in professional meetings. His broad background in
social anthropology committed him to interdisciplinary contacts with
psychology, political science, public administration, economics, and
history. His subsequent career at Columbia University and the Univer-
sity of Florida further expressed the breadth of his research and
teaching interests. He became nationally known in the developing
areas where anthropology touches medicine and education. Moreover, he
got around. His field work took him to Ireland, Wales, Saudi Arabia,
Brazil, Peru, and anywhere in the U.S. he happened to live and labor.
After his death in October 1982, the University of Florida remembered
him with an impressive memorial service, involving the participation
of colleagues from throughout the nation. At its December 1982 annual
meeting, the American Anthropological Association bestowed on him the
Bronislaw Malinowski Award, its highest honor in social anthropology.
In Alabama we recognize the benefits of his stay among us. The format
of the sessions is simple. Margaret Searcy, a student of his at Bama,
and Asael Hansen, a colleague earlier and a staff member here, lead
off. Others are invited to volunteer reminiscences and comments,
transforming the session into a memorial round table.

POROTIC HYPEROSTOSIS: A NEW HAMMER?

M. Cassandra Hill-Clark. Dept. of Anthropology, Univ. of Mass.,
Amherst, MA 01003.

The role of bioanthropological studies in the reconstruction of
past lifeways has greatly increased in importance during the past
decade. As scientific technology advances, the amount and quality of
information provided by skeletal studies will also continue to im-
prove. However, in this widening spiral of technology and enlight-
enment we must be aware of limitations in even the most sophisti-
cated techniques of analysis. There is an adage which states that
when Mommy gives Johnny a hammer, the universe suddenly becomes
poundable. As scientists, we must be careful not to abuse the capa-
bilities of information sources. For a case in point, this paper
discusses in detail the pathological condition most commonly referred
to as porotic hyperostosis, which has appeared in increasing frequen-
cy in archaeological reports, so much so, in fact, that it appears to
have become synonymous with maize horticulture. This paper provides
information about this pathology which admonishes those who would be
too eager to make the presumptive leap between two elements in a very
complex, interdependent system, while also being informative.

Abstracts

HEALTH AND SOCIAL RANK IN MISSISSIPPIAN MOUNDVILLE

Mary L. Powell, Northwestern University, Evanston, IL 60201

Peebles' (1974) mortuary analysis of 2034 burials from Mound-
ville partitioned the population into a series of hierarchical
clusters which crosscut key biological parameters of age and sex.
A minority of individuals had been accorded preferential access to
burial within certain precincts (in most cases,mounds), accompanied
by artifacts of restricted design and/or exotic materials, evidently
by virtue of their ascribed rank within the sociopolitical system.
The present study focuses upon observations of infectious disease,
nutritional deficiencies,traumatic injuries, bony neoplasms and
dental pathologies in 600 skeletal individuals selected from
Peebles' sample. One concern of the study is elucidation of pat-
terned distributions of pathological manifestations along both
biological and social dimensions. Examination to date of 71 sub-
adults and 222 adults suggests that infectious and traumatic invol-
vement were generally well buffered by adequate nutrition and that
no significant differences in disease experience attended varia-
tions in social rank.

A HAFTED GREENSTONE CELT FROM WEST CENTRAL ALABAMA

Charlotte Gyllenhaal-Davis, Department of Biology, University of
Alabama and Richard Walling, Office of Archaeological Research,
University of Alabama.

A hafted greenstone celt was recovered from the bottom of the
Black Warrior River. The celt is assignable to the Mississippian
era. The wooden haft is nearly intact. Electron microscope studies
indicate that the wood comes from a species of the white oak group
and that its three-dimensional cellular structure is basically sound.
Some signs of physical and biotic decay are present. The haft is now
being preserved using polyethylene glycol. Apparatus and techniques
of preservation will be discussed.

THE ADAPTIVE BASIS OF ORANG-UTAN SOCIAL ORGANIZATION

Bruce P. Wheatley. Dept. of Anthropology, Univ. of Ala. in Birmingham.
Birmingham, AL 35294.

The orang-utan is pivotal to our understanding of monkey, ape, and
hominid evolution. This report proposes a field study of the
behavior and ecology of this Asian great ape which will 1) reveal
the selective pressures responsible for the evolution of hominoid
and hominid morphology and 2) test the role of sexual selection and
feeding competition on this solitary ape. Preliminary data indicate
that while high and low quality food is abundant, the more critical
variable is its unpredictable spatial-temporal distribution. The
adaptive basis of orang-utan solitariness will be further evaluated
by examining its role as a seed dispersal agent of fruit trees with
a large energy payoff.

Abstracts

NONMETRIC VARIATION AMONG ARCHAIC AND MISSISSIPPIAN CRANIAL SERIES FROM THE PERRY SITE, 1LU25, NORTH ALABAMA

Michael A. DeLuca. Laboratory for Human Osteology, Univ. of Ala., University, AL 35486.

In 1970 John H. Romfh authored a thesis on human microevolution in prehistoric North Alabama based on an osteological sample drawn from the Perry Site (1LU25). He divided the skeletal material into three sequential cultural groups associated with three stratigraphic zones defined solely in terms of depth from surface. Romfh used frequencies of cranial and postcranial discrete traits for an assessment of morphological affinities among the three groups. This paper reevaluates Romfh's thesis using artifactual burial associations, rather than depth from surface, as bases for separating Archaic from Mississippian skeletal remains. Romfh's data are also tested for sexual dimorphism, as he failed to do this in his original analysis. These methodological errors found in Romfh's thesis undermine his conclusions concerning the biological continuity of the site's inhabitants.

TREE TIP-UPS: A COMMON CLASS OF FEATURES IN ARCHAEOLOGICAL DEPOSITS

Vernon James Knight, Jr. and Carlos Solis. Office of Archaeological Research, Univ. of Alabama, Moundville, AL 35474

For a variety of reasons, archaeologists have consistently misidentified a common class of natural feature informally known as a "tree tip-up." The most frequent misinterpretations have come through incorrectly attributing a purposeful cultural origin to these features. Using several newly documented examples from the literature, along with personally gathered data on others, we outline a number of variables which affect the form and content of these features as they appear at archaeological sites. We illustrate the general characteristics of the most frequently encountered forms.

GREENS AND GRITS: A STUDY OF RURAL SOUTHERN DIETARY PATTERNS

Janice Gilliland. Department of Anthropology, The University of Alabama.

This paper reports on the dietary and subsistence patterns of a biracial rural group representing both poor and middleclass families. The sample is drawn from residents of a small community in Hale County, Alabama. Special emphasis is placed on examining non-purchased food items maintained in the diet. Gardening, exchange systems, gathering, hunting and fishing are examined to determine the importance of these subsistence strategies in the total dietary pattern. Data from dietary pattern questionnaires and a 24 hour recall survey are used to establish food usage patterns. Dietary patterns will be discussed primarily in terms of subsistence strategies being utilized.

Abstracts

MISSISSIPPIAN FARMSTEADS AND THIER ECONOMIC SIGNIFICANCE IN THE
SOUTHEAST
Carlos Solos and Vernon James Knight, Jr. Office of Archaeological
Research, Univ. of Alabama, Moundville, AL 35474

The critical importance of relatively isolated, household-based
farming settlements to the understanding of the Mississippian
period (A.D. 950-1550) in the southeastern United States is
beginning to achieve proper recognition. However, we suggest that
inherited and largely spurious models of social integration and
corresponding schemes of site classification continue to cloud
the role and history of this basic economic unit of production.
In this paper we review the survey and excavation data on probable
farmsteads in three river valleys of the Southeast. We attempt
to trace the development of the farmstead as an aboriginal economic
unit of production from the Mississippian through the Protohistoric
and Colonial periods in these regions.

A TRADITION OF WHITE OAK BASKETRY IN THE SOUTHEAST

Lawrence Alexander, Anthro. Dept, U. of Ala., University, AL 35486

White Oak basketry is a folk tradition variously adapted
within different regions in the Southeastern United States. This
study examines the basket making tradition in Cannon County,
Tennessee. The ethnohistoric context in which basket makers
learn, practice, and maintain their craft and the economic and
social significance of basket making as a cottage industry in the
late nineteenth and early twentieth century is examined.

MINUTES

ALABAMA ACADEMY OF SCIENCE
ANNUAL BUSINESS MEETING
University of Alabama
Tuscaloosa, Alabama
March 4, 1983

AGENDA

1. Call to order by the President . . . . Charles Baugh
2. Report of Counselor to the AJAS . . . . Eugene O'Masta
3. Report of State Coordinator of Science Fairs . . . Elsie Spencer
4. Report of Gorgas Scholarship Foundation . . . . Leven Hazlegrove
5. Report of the Secretary . . . . Mike Lisano
6. Report of Place of Meeting Committee . . . . . . Phil Beasley
7. Report of the Resolutions Committee . . . . Hoyt Kaylor
8. Report of the Research Committee . . . . Carl Dixon
9. Nominating Committee Report . . . . William Mason
10. New Business
11. Adjourn

    Those reports listed here that were also presented at the Execu-
tive Committee Meeting are not reported here. Only Reports 4, 7, and
9 are presented.

    4. Report of Gorgas Scholarship Foundation as presented by Dr.
       Leven Hazlegrove:

    The Gorgas Scholarship Foundation announced today the rankings of
the finalists in the 1983 Alabama Science Talent Search. The search
was held at the meeting of the Alabama Academy of Science at the
University of Alabama, Tuscaloosa, Alabama.

    The winner of the cash award of $1,200 tuition grant was Tien
Minh Le, 240 Kent Lane, Homewood, AL 35209, from Homewood High School;
Teacher: Barbara Murphy.

Alternates were:

1st (and winner of a $500 tuition grant) Gregory Thomas Mount, 1014
    Desoto Avenue, Childersburg, AL 35044, from Childersburg High
    School; Teacher: Dean Ingram.

2nd (and winner of a $300 tuition grant) Lana Marie Hagel, 976 N.
    Martinwood Drive, Birmingham, AL 35235, from Huffman High
    School; Teacher: Robert S. Davis.

3rd James Howard Mason, III, 901 Weatherly Road, S.E., Huntsville,
    AL 35802, from Virgil I. Grissom High School; Teacher: Roberta
    A. Hill.

4th   Clark Darnell Baker, 807 South Church Street, Tuskegee, AL 36083, from Tuskegee Institute High; Teacher: Evangalene H. Burton.

5th   John Andrew Knox, 1108 Camellia Road, Birmingham, AL 35215, from Huffman High School; Teacher: Robert S. Davis.

6th   David Dayton Smalley, Route 7, Box 49, Florence, AL 35630, from Bradshaw High School; Teacher: Mary Nell Gonce.

7th   Michael Ernest Osborne, 206 Woodstock Drive, Florence, AL 35630, from Bradshaw High School; Teacher: Mary Nell Gonce.

8th   Matthew Grant, 565 Clayton Street, Montgomery, AL 36104, from Robert E. Lee High School; Teacher: John Ashley.

9th   Jerilyn Colquett Paulk, 702 East Hart Avenue, Opp, AL 36467, from Opp High School; Teacher: Elsie S. Spencer.

10th   Laura Lee Huckabee, 1100 McClung Avenue, Huntsville, AL 35801, from Huntsville High School; Teacher: Dorothy E. Dale.

The rankings were established by a panel of judges consisting of department heads, deans, and professors from many of the leading Universities and Industries in Alabama.

Dr. Leven S. Hazlegrove, Professor and Chairman, Department of Chemistry, Samford University, is Chairman of the Judges Committee.

Winners and alternates in the Gorgas Contests receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Foundation is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone, and later became the Surgeon General of the U.S. Army. The purposes of the Foundation are to promote interest in science and to aid in the education of promising students.

7. Report of the Resolutions Committee. Prepared by Dr. Hoyt Kaylor and presented by Dr. Lisano:

WHEREAS the Alabama Academy of Science has held its sixtieth annual meeting this March 1983 at the University of Alabama and has enjoyed the hospitality of the University, now therefore

BE IT RESOLVED that the Academy express its gratitude to Dr. Joab Thomas, President of the University, and to the University for hosting this meeting. To Dr. Stanley T. Jones and Dr. Joan Parsons Mitchell, Chairman and Associate Chairman of our local hosts, and to the members of their local host committee, John H. Burton, John C. Hall, Joe Murphy, Malcolm Portera, Gary L. Sloan, and James D. Walker; to the Faculty and Staff of the University; and to all the many others who contributed to the success of this meeting, we, the members of the Academy, express our appreciation for their efforts on our behalf.

␧

NOTES

Publication and Subscription Policies

Submission of Manuscripts. Submit all manuscripts and pertinent correspondence to the EDITOR. Each manuscript will receive two simultaneous reviews. For style details, follow Instruction to Authors (see inside back cover).

Reprints: Requests for reprints must be addressed to authors.

Subscriptions and Journal Exchanges: Address all correspondence to the CHAIRMAN OF THE EDITORIAL BOARD.

CONTENTS

CALL FOR NOMINATION
WRIGHT A. GARDNER AWARD

The Wright A. Gardner Award is to be presented by the Alabama Academy of Science to an individual for outstanding achievement in science during residence in Alabama. The award will be presented for the first time at the 1984 Annual Meeting. A call for nominations is being made at this time.

Academy members are invited to submit nominations for the Gardner Award; however, anyone is eligible to nominate a worthy candidate. A nomination must be accompanied by a typed biography for the nominee and a citation suitable for reading at the time of the presentation. Supporting letters of recommendation are also encouraged. All documentation should be directed to W. H. Mason, 101 Cary Hall, Auburn University, AL 36849. Nomination materials must be received by February 1, 1984.

LETTERS

Dear Friends and Colleagues:

At the half-way point in my term as President, I wish to report that progress continues in Academy spheres of influence such as membership, science education, annual meetings, science fairs and other AJAS activities, awards, journal and newsletter, etc. This progress stems from continued efforts of many members, officers, and committee chairpersons.

Please keep the Academy and its programs in mind throughout the year. I especially would like to ask you to remember the annual meeting on the University of South Alabama Campus on March 14-16, 1984. Please plan to attend, present a paper, and submit the paper to the *Journal* for publication.

Due to the efforts of former President Charles Baugh and others, we now have a membership certificate which is much nicer than the old one. All members may receive a new certificate by sending your request and one dollar ($1.00) to Dr. Mike Lisano, Secretary, AAS, Department of Zoology-Entomology, Auburn University, AL 36849.

I also would like to remind you of our Wright A. Gardner Award of noteworthy acheivement in the field of Science by an individual during residence in Alabama. If you would like to nominate a candidate for this award contact Dr. W. H. Mason, 101 Cary Hall, Auburn University, AL 36849.

Best wishes for success in your scientific endeavors.

Sincerely yours,
Raymond E. Isbell, President
Alabama Academy of Science

Dear Academy Members:

This year in planning for the annual meeting, the Academy is seeking to offer continuing education units (CEU's) on contact hour credits for persons attending the scientific sessions.

This is envisioned as benefitting both the Academy and the scientific community as a whole in Alabama, but it is also seen as having the potential to alter the overall tone of the meeting.

Continuing Education refers to short-term programs designed for professionals to maintain and improve skills. Continuing education is part of a lifelong learning process, but has taken a more concrete form with respect to health care professionals and educators. Individuals in those groups are frequently required by state law or board regulations to participate in a specified number of continuing education activities each year. Thus, Academy officers began to explore the possibility of offering continuing education units for professionals attending AAS meetings.

There are many potential benefits of offering CEU's to the Academy. It is possible that such an offering would greatly increase the number of individuals attending the meeting. This would encourage the development of special symposia directed toward topics of interest, and might encourage the creation of interdisciplinary symposia directed toward specific target audiences.

Potential benefits to the scientific community at large may be less tangible but no less real or valuable. The participation by practicing professionals--teachers, physicians, pharmacists, nurses, physical therapists, and others--would be a means of drawing the scientist/ researcher closer to the profes-

sional consumers of scientific findings. It could provide a significant developmental role-modeling effect for both science teachers and health practitioners, and perhaps provide a milieu in which personal-professional linkages could be formed between individuals who share common interests, but who serve the community in differing capacities. Finally, through such contacts and linkages a measure of accountability is required of scientists. The scientists who function in such relationships must be able to demonstrate the significance of their endeavors.

The possible disadvantages of such an undertaking should also be enumerated. First there is little guarantee that professionals will choose to attend the scientific sessions of the Academy, especially when other organizations abound. Some of the Academy members may question the propriety of reaching out to develop a professional audience. Certainly, the tone of many scientific sessions has been that of scientist talking to scientist in specialty-specific language; presenters may feel less comfortable speaking to an audience which represents not only varied disciplines but also varied levels of scientific expertise.

With these potential disadvantages in mind, plans are underway to offer CEU's through the University of South Alabama as host institution for the 1984 meeting. It is anticipated that the host institutions in future years would be of similar assistance. Approvals from state and professional boards are being

sought. If Academy members have other suggestions for groups which could be contacted, they should share those with the administrative officer. Comments as to other advantages/disadvantages and evaluative statements after the Spring meeting are likewise encouraged. Perhaps the ideals embodied in the envisioned benefits are too lofty. Perhaps the Academy is not an organization which can facilitate the communication of scientific and mathematical concepts to the larger community. Alternatively, perhaps outreach is a most appropriate developmental step for the Academy at this time.

Sincerely,
Ellen B. Buckner, Chairperson
Health Sciences Section

Biology Section Members:

The 1984 Annual Meeting scheduled for Mobile promises to be the best ever for the Biology Section. In addition to the usual events, we are planning a field trip to the Dauphin Island Sea Lab. Activities there will include a tour of the facilities and an opportunity to explore and collect at various beaches and marshes. Let's all do our part this year by attending the meeting, presenting papers, and participating in the field trip. Hope to see you in Mobile!

Sincerely,
Larry Wit, Chairman
Biological Sciences Section

RADIOTELEMETRIC OBSERVATIONS OF WINTERING SNAPPING TURTLES
(*CHELYDRA SERPENTINA*) IN RHODE ISLAND[1]

Gordon R. Ultsch
Department of Biology
University of Alabama
Tuscaloosa, AL 35486

and

Dennis Lee
Division of Biology and Medicine
Brown University
Providence, RI 02912

ABSTRACT

Five snapping turtles *(Chelydra serpentina)* were collected from the Connecticut River near Essex, Connecticut, and fitted with waterproof radiotransmitters. They were released into a small pond in Rhode Island in October 1979, and their movements were followed until the following May. Movements occurred from the release date until 4 December, with the frequency of burial in mud increasing as winter approached; on that date, all turtles had moved into the inlet stream of the pond and buried themselves in mud near the shore. They remained there without moving until 24 March, at which time it was discovered that two had frozen. The study suggests that *Chelydra* prefers shallow waters as a location for its hibernaculum and does not move during its hibernation period.

INTRODUCTION

In recent studies of *Chrysemys picta bellii* (Jackson & Ultsch, 1982; Ultsch & Jackson, 1982a and b), it was found that turtles submerged at 3 C in water that was nearly anoxic (PO_2 < 5 mmHg) could survive for as long as 6 months, but that their physiological condition was clearly stressed, mainly due to a severe lactic acidosis. In contrast, turtles kept in aerated water were much less acidotic, and in some cases were physiologically indistinguishable, after 2 months submergence, from controls with access to air. This was clearly due to extrapulmonary uptake of oxygen from the water. Furthermore, animals kept in low-O_2 water which was then aerated showed immediate physiological improvements, including elevation in blood pH, elevation of arterial PO_2, stabilization of blood lactate, and cessation of CL^- and HCO^{-3} loss.

These observations suggested that hibernating turtles, particularly in the northern parts of their ranges where the duration of hibernation is lengthy, could benefit either by not burrowing under mud, which is

---

[1]Manuscript received 5 May 1983; accepted 21 June 1983.

essentially an anoxic microhabitat, or by periodically leaving such a hibernaculum to enter water of high PO_2. There are occassional but unspecific published (Carr, 1952; Ernst and Barbour, 1972; Gibbons, 1967; Sexton, 1959) and unpublished (R. Meeks, personal communication) observations of winter movements in turtles; however, we found no published studies following individual aquatic turtles through an entire winter.

Since we knew that aquatic respiration could be an important factor in wintertime survival, we followed the winter movements of some turtles to determine if they located, either permanently or periodically, in microenvironments where they could take advantage of their ability to utilize the oxygen available in the water. We chose *Chelydra serpentina* for preliminary studies because of its large size, and because of its reputed ability to take up O_2 from water (Gatten, 1980).

MATERIALS AND METHODS

Snapping turtles were trapped in the Connecticut River, Middlesex County, Connecticut during September 1979. Five (carapace length 22-35 cm) were fitted with radiotransmitters (Telonics 1SB5 with TA-55 antennas) attached to the rear edge of the carapace; the antennas were attached along the edge of the marginal scutes. Identifying numbers (3-7) were painted on the carapace. The turtles were released on 11 October 1979 at Little Camp Pond; a dammed, man-made pond (ca. 0.8 hectare) on the research grounds of the Alton-Jones Campus of the University of Rhode Island in Kent County, Rhode Island.

The turtles were located at later dates with a receiver (Telonics TR-2), and their position validated by feeling for the shell by hand; the location was then marked with a numbered float. Findings and environmental measurements were performed weekly until mid-December, when the turtles ceased moving, and at longer intervals thereafter. Because our primary interest was whether or not movements occur during the coldest portion of the winter (mid-December to mid-March) we did not wait for the turtles to voluntarily emerge when it appeared that they would do so imminently, as evidenced by the advent of warm weather and activity of other turtle species. On 24 March we attempted to precisely locate all 5 and sample their blood by cardiac puncture, which effectively ended the study of natural winter behavior.

RESULTS AND DISCUSSION

The results of wintertime behavior and associated environmental measurements are summarized in Table 1. The following general trends were found:
1. In October the turtles routinely moved from their previous locations. They were found buried in the mud 60% of the time. This contrasts with the April and May data that indicate that mud-burial is not common during the warmer parts of the year, although our data for that time of the year are sparse. The turtles tended to be restricted to the shallow portion of the pond near its inlet stream, but did not enter the inlet stream.

TABLE 1. Field data concerning the locations of radio-tracked snapping turtles followed from October 1979–May 1980. Data are given as ranges, except for air temperature which was a single value.

DATES OF FIELD OBSERVATIONS (1979–1980)

	OCTOBER					NOVEMBER				
	12	15	18	23	26	1	6	13	20	27
# Turtles Located	5	5	5	5	5	5	4	4	4	5
Air Temperature (°C)	–	12	17	22	9	–	12	5	14	11
Bottom Water Temperature (°C)	9.0–9.5	9.0–10.8	10.5–12.0	16.0–20.0	9.8–10.5	–	8.0–10.0	7.2–8.0	7.0–9.0	10.0
Meters moved and # Moved (N)	–	20 (1)	15–60 (4)	30–125 (4)	4–78 (5)	1–60 (5)	10–60 (4)	8–400 (3)	1–40 (3)	40–70 (3)
Water Depth (cm)	40–60	17–55	8–28	15–58	19–63	20–31	0–20	0–26	15–58	1–22
Cm Buried and # Buried (N)	5–10 (3)	5 (2)	5–10 (4)	10 (1)	15 (4)	2–10 (4)	5–40 (4)	4–38 (4)	2–10 (4)	4–10 (5)

TABLE 1. (continued)

DATES OF FIELD OBSERVATIONS (1979-1980)

	DECEMBER				JANUARY		FEBRUARY	
	4	12	18	27	8	22	6	22
# Turtles Located	5	5	5	5	5	5	5	5
Air Temperature (°C)	3	12	-4	4	2	2	-1	0
Bottom Water Temperature (°C)	2.5-4.0	5.0-7.0	0.4-3.0	5.5-6.0	0-3.0	0.5-3.0	ICE	ICE
Meters moved and # Moved (N)	1-450 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Water Depth (cm)	0-11	0-7	0-12	1-15	0-10	0-7	-	-
Cm Buried and # Buried (N)	6-19 (5)	2-24 (5)	4-14 (5)	4-14 (5)	4-14 (5)	4-14 (5)	-	-

TABLE 1. (concluded)

DATES OF FIELD OBSERVATIONS (1979-1980)

	MARCH			APRIL		MAY	
	19	24*	28**	1	20	10	21
# Turtles Located	5	5	1	2	2	2	2
Air Temperature (°C)	9	-	12	12	22	18	-
Bottom Water Temperature (°C)	1.5-6.5	6.0-6.5	12.5	9.0	10.5-14.0	18.0	-
Meters Moved and # Moved (N)	0 (0)	-	30 (1)	50-100 (2)	40-50 (2)	20-30 (2)	10-50 (2)
Water Depth (cm)	9-10	-	35	10-30	50-100	30-60	60-100
Cm Buried and # Buried (N)	1-20 (5)	-	5 (1)	10 (1)	0 (0)	0 (0)	0 (0)

* Two turtles were found to be dead (frozen); 2 others were removed from the mud for blood sampling, and released after sampling. Other species (*Chrysemys picta* and *Clemmys guttata*) were seen sunning for the first time in 1980.

** The last turtle was removed from under the bank in the mud, and actively resisted his eventual removal and release. One of the blood-sampled turtles was found dead, leaving 2 turtles for the remaining data.

2. In November, as air and water temperatures fell, movements continued to occur, but the incidence of mud-burial increased to 95%. Toward the end of the month the turtles tended to move toward the inlet stream.

3. In early December, the turtles had all located in sites near or under the shores of the inlet stream within 20-40 m of the pond, as the water and air temperatures fell to low levels. The animals remained there, without discernable movement, throughout the rest of the study period until we disturbed them on 24 March.

Wintering locations were under the bank or in the mud of small tributaries between tree roots or grass tussocks. Finding such a location appeared to be more important than the depth of the water around it, as suggested by the death (apparently by freezing) of turtles 4 and 6. Number 4 was buried in a mudform just above water level, with the top of its carapace even with the mud line. Number 6 was buried about 5 cm below the mud surface in what was initially 10 cm of water; however, falling water levels during the winter left it covered by only 1-3 cm of water, which was completely frozen for several intervals of weeks in January-February.

The presumably unnatural death of turtles 4 and 6 by freezing because of their location in either shallow water or exposed mud is not readily explainable. We suspected that these 2 turtles would relocate as winter progressed, but they did not, and we can only hypothesize that the structure of the pond was unfamiliar to these animals and resulted in a poor choice of microhabitats within the larger hibernation area.

Nevertheless, 3 *Chelydra* did survive in sites not greatly different from those that proved lethal for the 2 that froze. More importantly, all turtles moved to the same area (the inlet stream) for hibernation, and none moved throughout the winter. This observation that snapping turtles do not move throughout their hibernation period can be supported by the reports of other authors (Cahn, 1937; Ernst and Barbour, 1972; Pope, 1939) who state that snapping turtles often tend to congregate in large numbers in muskrat burrows, holes under the bank, and similar locations for hibernation. For example, Cahn (1937) reported finding 26 large *Chelydra* in a muskrat burrow; this would assumedly preclude relocation during the winter, since it would appear that the last few of the 26 would effectively block the exit of others from the burrow. Moreover, the tendency of *Chelydra* to move into shallow waters for hibernation has also been noted by Obbard and Brooks (1981) and Meeks (unpublished observations). This tendency may be related to the use of temperature as a spring emergence cue, since such waters would be the first to warm in springtime, and may explain why all 5 *Chelydra* chose the inlet stream as a hibernation site, even though they were not found there prior to hibernation.

LITERATURE CITED

Cahn, A. R. 1937. The turtles of Illinois. University of Illinois Biological Monographs 16:1-128. Urbana, Illinois.
Carr, A. F. 1952. Handbook of turtles. Cornell University Press, Ithaca, New York.
Ernst, C. H. and R. W. Barbour. 1972. Turtles of the United States. University of Kentucky Press, Lexington.
Gatten, R. E. 1980. Aerial and aquatic oxygen uptake by freely-diving snapping turtles, (*Chelydra serpentina*). Oecologia (Berl.) 46:266-71.
Gibbons, J. W. 1967. Possible underwater thermoregulation by turtles. Can. J. Zool. 45:585.
Jackson, D. C. and G. R. Ultsch. 1982. Long-term submergence at 3 C of the turtle, *Chrysemys picta bellii*, in normoxic and severely hypoxic water--II. Extracellular ionic responses to extreme lactic acidosis. J. Exp. Biol. 96:29-43.
Obbard, M. E. and R. J. Brooks. 1981. A radio-telemetry and markrecapture study of activity in the common snapping turtle, *Chelydra serpentina*. Copeia 1981:630-637.
Pope, C. H. 1939. Turtles of the United States and Canada. Alfred A. Knopf, Inc., New York.
Sexton, O. J. 1959. Spatial and temporal movements of a population of the painted turtle *Chrysemys picta marginata* (Agassiz). Ecol. Monogr. 29:113-140.
Ultsch, G. R. and D. C. Jackson. 1982a. Long-term submergence at 3 C of the turtle, *Chrysemys picta bellii*, in normoxic and severely hypoxic water--I. Survival, gas exchange and acid-base status. J. Exp. Biol. 96:11-28.
Ultsch, G. R. and D. C. Jackson. 1982b. Long-term submergence at 3 C of the turtle *Chrysemys picta bellii* in normoxic and severely hypoxic water--III. Effects of changes in ambient PO_2 and subsequent air breathing. J. Exp. Biol. 97:87-99.

STATE DEPARTMENTS OF COMMUNITY AFFAIRS:
PURPOSE AND PROSPECT[0]

Barbara M. Giles
*Department of Political Science
Auburn University
Auburn University, Alabama 36849*

INTRODUCTION

The constitutional status of local governments is one of subordination to state governments, but local governments have always played an important part in the intergovernmental structure of the federal system. For the first time, in 1920 according to the census, urban population outnumbered rural population and government in the United States was predominantly local government. At that time, expenditures of all local governments exceeded those of the states and national government combined. This remained true until the middle 1930s. With the Great Depression, subsequent war, and the new positive role demanded of all units of government, the prominence of local governments diminished relatively. Today the federal government is the biggest financier of domestic activities, with the states ranking second.[1]

While urban centers, with their related problems, remain the focal point of states' interest in addressing needs of local governments, all local governments, rural as well as urban, have become increasingly subservient to state and federal agencies for financial aid. For the most part, this aid has been provided by traditional governmental structures; the federal government did create additional cabinet level structures during the 1960s to better handle the growing body of relationships with cities. The most prominent of these was the Department of Housing and Urban Development established in 1963. State structures on the other hand, remained virtually unchanged prior to the 1960s. The past two decades, however, have witnessed a gradual but steady development of departments of community affairs (DCAs), state agencies which address themselves to needs of local governments. It is the objective of this paper to examine the purpose for creating DCAs, the support given for their creation, the status and organization of DCAs and their potential role for the future.

The relative success of states in establishing these agencies may do much to improve the unheavenly city and the lost world of municipal government. Moreover, should President Reagan's new federalism arrive some time during the 1980s, local governments will need more realistic help

---

from states than ever before. Accelerating change of the 1960s and 1970s may dictate that the department of community affairs shall become the most innovative and useful link between state and local governments in the nation.

BACKGROUND

It was during the decade of the 1960s, an "era of expansion", the New Frontier and particularly the Johnson Administration's Great Society programs that the number and cost of grant-in-aid programs made available by the federal government skyrocketed. With the passage of the Sixteenth Amendment to the United States Constitution in 1913, a few grant-in-aid programs had been enacted, but this form of financial assistance did not become a significant factor in governmental expenditures until after World War II. The categorical grants produced by Johnson's Great society program were part of a broader program labelled Creative Federalism. Many of the 240 programs enacted during a five year period (1964-1969) were aimed at curing ills of the nation's cities. Thus, much of the money was channeled to local governments directly from the federal level resulting in an imbalance in the intergovernmental structure. While the United States Constitution does not mention local governments, in practice there has been growth in direct relations between Washington and the cities.

The decade of the 1970s witnessed more of the same. The federal government continued to assist state and local governments in attempting to solve the nation's problems. The cost of total federal grant-in-aid expenditures increased from $7 billion in 1960 to over $24 billion in 1970 to over $91 billion by 1980. The number of categorical grants increased by more than 200 since 1969 bringing the total to around 600 by the end of the 1970s.

Some attempt was made to return power and responsibilities to state and local governments through use of block grants and revenue sharing which were introduced in the late 1960s and early 1970s, respectively.[2] However, neither form of financial assistance constituted a large percentage of federal expenditures.[3] As a result categorical grants have remained the primary source of federal assistance made available to state and local governments during the past two decades, and the federal government has become the center of power in the intergovernmental system.

Due to the many strings attached to categorical grants, along with an increase in number of grant programs available, there occurred an increase in administrative requirements accompanying these programs. Critics of federal spending to aid cities during the '60s argued that spending had increased by 100 times in the preceeding 30 years and that problems had either remained or were becoming worse. Referring to the extent of red tape involved in the federal bureaucracy, it was stated that there were ten times as many federal agencies dealing with city affairs in the 1960s as there were in 1939; and paperwork in the field had risen by 1000 percent. According to critics:

Social workers in New York city are . . . spending up to 80% of their time filling out reports for federal, state and city governments leaving little time for direct contact with the poor. Moreover, government officials contend that more and more supervision is necessary to keep expanding programs under control, and insist that most government projects within limits set for them have succeeded.[4]

The situation worsened during the 1970s. In fact, it was during this time that mandates increased dramatically. Prior to 1960 it is estimated that the federal government imposed only 14 mandates while by 1970 that number had increased to 178. The work of Catherine H. Lovell and others, "Federal and State Mandating on Local Government: An Exploration of Issues and Impacts" and William E. Hudson, "The New Federalism Paradox" best described the situation in 1981.

Today it is estimated that the federal government imposes 1,259 mandates on state and local governments, 223 of which are direct orders and the rest (1,036) conditions of aid. Fifty-nine of these mandates constitute cross-cutting regulations (relating for instance, to such matters as civil rights, environmental protection, and merit staffing) which apply to most federal grants regardless of their specific purpose.[5]

The result of an expanding federal grant system accompanied by increasing administrative regulations was a management mess characterized by duplication and inefficiency. The comments made by Congressman William Roth (Del.) in 1969 about the status of categorical grants were relevant a decade later. Roth stated, "There are so many of a similar nature scattered among diverse agencies and departments, it is a wonder that the potential recipients of Federal aid can ever find their way through the maze of Federal assistance programs."[6]

The need for an agency at the state level to coordinate available programs and assist local governments in making most efficient use of available resources grew more apparent as the federal grant system continued to expand. The case for state departments of community affairs was recognized as early as 1961 by Professor John Bedout who stated:

. . . The nature and importance of the States' responsibility with respect to local government fully justify establishing a principal State department of local affairs. It is true that many departments in the State government have dealings of various kinds with local government or with counterpart agencies in local government. It is not suggested that a State department of local affairs should supercede or take over many of these departmental relationships. There is, however, in virtually every State government an unmet need for informational, research, clearinghouse, advisor, and technical assistance activities with respect to local government that could best be provided in a single strong department.[7]

In the early 1960s states had attempted to respond to urban problems from a position of weakness. It was necessary for states to set their own houses in order before they could meet responsibilities and needs of their local governments. The Office of Federal-State Relations had attributed much of the difficulty in coordinating and administering an urban program to needed reforms in state government. It noted:

> *Many Governors are faced with archaic state constitutions and inadequate statutory authority for effective administration of urban program activities at the state level. Although a number of states have made significant administrative adaptations for handling urban affairs activities, most states still do not have effective administrative machinery for implementation of a coordinated urban affairs program.* [8]

The states did take some significant action during the decades of the 1960s and 1970s to enable them to deal more efficiently with urban problems. Changes in the executive branch included strengthening the governors' tenure power. Several significant changes were made in the legislative branch including use of annual sessions in more states. However, of great potential significance in resolving urban problems were United States Supreme Court decisions calling for reapportionment of state legislatures. With the decision in Reynolds v. Sims, the urban populations would now be proportionallly represented within both houses of the state legislature. [9] Along with attempting to strengthen their executive and legislative branches of state government, some states also attempted to strengthen their fiscal resources by levying a personal income tax.

While all of these factors were important in building a solid foundation for states to respond to urban problems of this nation, creation of state departments of local affairs had a more direct bearing on efforts to remedy problems plaguing the nation's cities. In light of the urban problems and maze of federal grant programs aimed at alleviating them, local governments were in need of a one-stop service where communications focus on all programs of assistance available to them and requirements for utilization of these funds. During the 1960s and 1970s states responded incrementally to support rendered by several agencies by creating departments of community affairs.

SUPPORT FOR DCAs

Several organizations recognized need for agencies of local affairs to be established at the state level in an attempt to restore balance to the federal system of government. It seemed logical in light of the constitutional framework that such agencies be established at the state level and that local governments work with these state agencies using federal assistance to resolve urban problems.

As early as 1956 The Council of State Governments recommended the creation of a state agency for local affairs. In a report for the Governors' Conference the Council recommended that a state agency could:

> . . . *aid in determining the present and changing needs of its urban*
> *areas, . . . serve as a focal point of information and evaluation*
> *about metropolitan and local problems and relations and . . . develop*
> *suggested remedies and assistance programs . . . assist and advise*
> *the governor in coordinating state services affecting local govern-*
> *ments, recommend changes in state legislation and programs, ...*
> *serve as clearinghouse of information and provide technical assis-*
> *tance to local governments, and consult and cooperate with other*
> *state agencies, local governments and federal agencies.*[10]

In 1962 the National Governors' Conference supported creation of a
state agency. Later a staff study prepared for the Committee on State-
Urban Relations of the National Governors' Conference insisted that the
states must create, develop and finance adequate state agencies to conduct
local programs and they must also strengthen existing programs. Moreover,
failure to do this, according to the study, would likely result in a sig-
nificant increase in direct federal intervention in local affairs.[11] It
was felt that neglect by states in the past was partly responsible for
lack of coordination of programs, and the "scattering of urban related
programs among numerous state agencies". Moreover, "the very multiplicity
of federal programs demands improved coordinative devices and more ra-
tional management procedures to handle growing workloads in state capi-
tols."[12]

Along with The Council of State Governments and the National Gover-
nors' Conference, other organizations strongly encouraged creation of such
an agency. Support was provided by the National Conference of Mayors in
1962; the National League of Cities added its endorsement in 1964; the
National Association of Housing and Redevelopment supported such a cre-
ation in 1965. It has also been noted that the Advisory Commission on
Intergovernmental Relations had been constant in its support for creation
of a state agency for local affairs since the Commission was established
by Congress in 1959.[13]

In addition to verbal support provided by these agencies Congress
provided financial and administrative aid to states in efforts to create
such agencies. For example, support was indicated by Title IX of the
Demonstration Cities and Metropolitan Development Act of 1966 which autho-
rized financial support for studies of state constitutional and statutory
requirements necessary to strengthen state–local capacity to deal with
urban problems.[14] The money could be used to establish the agency itself
and pay for staff salaries, although states had to provide matching funds.
Additional Congressional pressure or incentives were indicated by other
programs including the following:

1. Federal State Training Programs authorized under the Housing Act
of 1964 (P.L. 89-329), Part I, Title VII.
2. Community Service and Continuing Education Programs authorized by
the Higher Education Act of 1965, (P.L. 89-329), Title I.
3. The Urban Planning Assistance Program authorized under Section

701 of the Housing Act of 1954, as amended (P.L. 560).
4. The Urban Information and Technical Assistance Program authorized under Title IX of the Demonstration Cities and Metropolitan Development Act of 1966 (P.L. 89-854).
5. The Federal Information Exchange of the Office of Economic Opportunity authorized under Section 613 of the Economic Opportunity Act of 1964, as amended.
6. The Model Cities Program authorized under Title I of the Demonstration Cities and Metropolitan Development Act of 1966 (P.L. 754) and Title X, Section 1008 of this act which amends the 701 program to provide federal funds for studies of state statutes affecting local government.[15]

Collectively, these six programs provided assistance for establishment of a central state agency to handle local affairs. With the sole exception of Model Cities, all of these programs required formal legal action by state governments and were routed directly through the states. Furthermore, it was pointed out, "effective implementation of these programs to insure maximum utilization of fiscal resources is possible only through the willingness and responsiveness of state government to provide a unified state level administrative structure for urban program coordination."[16] Diffusion of administrative responsibility by scattering program execution among numerous state agencies can add to confusion, commucation collapse, and dilution of program effectiveness.

In addition to efforts of Congress, the executive branch also focused its attention on urban problems. For example, President Nixon in one of his first official acts after inauguration created an Urban Affairs Council. Headed by Daniel P. Moynihan and modeled after the National Security Council, the Urban Affairs Council was charged with the primary task to ". . . advise and assist him . . . in the development of a national urban policy." In so doing Moynihan established ten "guides" to urban policy. While several of these guides attempted to define the role of the federal government in responding to urban problems, the guidelines also supported and encouraged state governments to carry out their own responsibilities in urban affairs.[17]

Thus, support for creating state departments of community affairs was widespread. In addition to support rendered by national organizations representing both state and local governmental officials, the national legislative and executive branches also encouraged development of such agencies. Support appeared unanimous. What were the results?

CREATION OF DCAs

In spite of apparent need for DCAs, due to the maze of available federal grants in the 1960s and 1970s, as well as support for DCAs demonstrated by several organizations, states responded slowly to creating such agencies. While Pennsylvania created an agency for local affairs as early as 1919 and New Jersey followed in 1938, these agencies were involved in financial supervision and not provision of state services to help local

governments per se. It was not until 1959 that a modern state service agency was created when New York established the Office for Local Government; that agency sought to advise and aid local governments in obtaining federal financial aid. The decade of the 1960s saw a dramatic increase in establishment of state agencies for local affairs. By the end of the 1960s 26 states had responded to the need for DCAs either by creating such an agency per se or by designating an existing agency to perform similar functions. By 1975 an additional 12 states were added to those boasting such agencies[18] and by of the end of the 1970s the task of establishing such an agency, in varying forms and possessing varying powers, had been accomplished in all 50 states.

While efforts of early DCAs focused on certain needs, during the 1970s their role was expanded to accommodate needs of rural communities as well. This change is reflected at the federal level with establishment of departments which encouraged and assisted the workings of DCAs. In 1963 the federal government created the Department of Housing and Urban Development. However, it was recognized that urban development could not be successful if rural and regional needs were neglected. Thus, in the 1970s the term community development came into vogue with enactment of the 1974 Housing and Community Development Act. States and their respective agencies adapted to this change by assuming a more comprehensive approach in dealing with particular problems of local government.

In addition to broadening their responsibilities somewhat over time, there were individual differences among state DCAs in terms of status, organization and functions. In creating agencies for local affairs states differed as to whether they provided for the agency to function independently or as an adjunct to the State Planning Office. For example, in Connecticut, Florida, and Massachusetts state agencies for local affairs were actually called Departments of Community Affairs. However, in some states like Alabama, New Mexico, and Maine they are regarded to be part of the Office of State Planning. In all, 35 are considered to be cabinet level offices while six are located in the Governor's office and nine others within another executive department.[19] Only ten of the total are actually titled "Department of Community Affairs".

In an attempt to involve local officials in the workings of DCAs approximately half of the states have established advisory boards. The advisory boards, usually small in number, averaging 15 members, are composed exclusively of local officials. The primary purpose in establishing the boards was to allow local officials input into state programs which directly affected local government. However, the impact of local officials in this capacity for the most part is minimal. The role of the boards is strictly "advisory" and usually limited to a narrow range of policy areas. In addition, the boards lack staff and financial resources which restrict any notable contributions. On the positive side, advisory boards have been described as "good sounding boards for local problems."[20] Department of Community Affairs advisory boards serve as an "effective communication link between DCA and local officials"[21] and in a limited number of instances have had a significant impact on specific policies and programs.

213

In addition to organizational differences between state agencies for local affairs, internal differences in size of staff, budget and functions vary widely from state to state. Staff sizes range from fewer than 50 to over 500; a total of over a billion dollars was spent by these agencies in 1977.[22] In terms of functions these state agencies may be divided into three categories:

1) In some states their function is narrow in scope and focuses on technical assistance, planning, management and training.
2) In other states the departments are responsible for all of the aforementioned duties as well as housing and human resources.
3) And in some states their function is comprehensive, encompassing both sets of responsibilities specified in 1 and 2 in addition to economic development activities.[23]

While functions of DCAs vary greatly among the 50 states at present, the most common functions include assistance in improving general local government planning and management, help in managing specific programs in housing and community development, and encouraging intergovernmental cooperation. In administering these functions DCAs may assume various roles. For example, in management assistance responsibilities DCA roles may include those of consultant, technical authority and convener of resources, just to cite a few. In addition to technical assistance and services to local governments, however, more importantly, DCAs have the potential to play an important role within the federal system. In the 1960s when such agencies were first being established the Committee on State-Urban Relations stated, "The local affairs agencies constitute a 'missing link' between localities and the two higher levels of government and bears testimony to the states desire to promote efficiency in the use of resources available to solve community problems."[24] The importance of DCAs in this regard has continued to the present time. As described in the Book of States 1978-79, "A . . . . . . common function of DCAs is their mandated responsibility to encourage intergovernmental cooperation. DCAs often serve as brokers between federal and state agencies and local governments both as mobilizers of federal-state resources and as advocates for needed federal and state legislative and policy changes."[25]

THE FUTURE OF DCAs

The future of DCAs is potentially challenging. The perceived need to restore balance to the intergovernmental system by enhancing the role of state governments has long been recognized. The Reagan Administration efforts to create a "New Federalism" potentially provide DCAs an opportunity to play an increasingly important role in state government. However, in 1983 that program remains in limbo.

Need to enhance the role of state government within the intergovernmental system is apparent to many persons. Former Governor George Busbee of Georgia, speaking on behalf of other governors and state officials at

an annual meeting of officials of the nation's state community affairs agencies stated, "State governments can respond to problems of greatest need within their states with greater comprehensiveness, speed and flexibility than a remote federal government."[26]

An area which may be particularly appropriate, constitutionally, for state government to enhance its role in the intergovernmental system is through community and economic development programs. The federal government appears supportive of this change. As reported in The Book of States 1978-79:

> . . . *new initiatives by the federal government will incorporate the states as partners in federal community development strategies. As the state-federal partnership evolves, it will become imperative that states develop mechanisms and programs through which local governments and citizens can influence decision-making processes at the state level as they relate to the allocation and use of federal funds.* [27]

Since the late 1970s states have responded, however unequally, to renewing an interest in the welfare of local governments. As reported in The Book of States 1980-81, ". . . the state's attention to both urban and rural needs reflects a maturation of state interest in and commitment to its communities."[28] While this is a step in the right direction, it is further recognized that states need to improve efforts in this regard. In "The States and Distressed Communities 1980 Annual Report" it is stated, ". . . while the states are emerging as the architects of urban and rural development policies, few states have made extensive use of the full range of powers and tools at their disposal."[29] The states have incorporated their economic and community development activities into the organizational structure of DCAs.

Thus, the political climate has appeared ripe for several years for state departments of community affairs to broaden their responsibilities and assist state governments in restoring balance to the intergovernmental system. In the late 1970s state officials recognized the apprehension of local officials regarding the present role of DCAs. Local officials had become used to working directly with the federal government and resented DCAs functioning as an intermediary in linking these two governments. State officials rationalized that DCAs would have to establish "credibility by providing needed resources and services to local governments and advocating for their interest to state and federal levels"[30] before local officials would accept the more extensive role of DCAs as change agents for local governments. It appears DCAs have partially established themselves as service providers and advocates for local government in many jurisdictions and that greater efforts may be made to broaden functions and responsibilities of DCAs. The COSCAA 1978 report on DCAs indicates that these state agencies are well established as service providers and advocates for local government:

> . . . the record to date indicates that most DCAs have attempted to develop reputations as effective service providers and advocates for local governments. Very few have undertaken major initiatives to change the form of local governments or to force a more comprehensive approach to local problems. [31]

It may be anticipated also that as functions and responsibilities of DCAs are enhanced, these agencies may increase in power and influence and become important agents for the states—serving all three levels of government. As reported in The Book of States 1978-79:

> The broader constituencies which DCAs will acquire through additional program area responsibilities will help to stabilize legislative and gubernatorial support. This support is essential to acquire increased appropriation levels and to strengthen staff resources which allow DCAs to provide a fuller response to the expectation held of them. [32]

While many DCAs can become more important by broadening their own responsibilities, several objectives of the Reagan Administration also have potential for enhancing importance of these agencies. A major goal of the President as indicated by his State of the Union address on January 26, 1982 was to create a "New Federalism". The principle behind the proposed program is to restore balance to the intergovernmental system by returning certain powers and authority to state and local governments. Should the program succeed, machinery already established by state governments (like DCAs) could become critical to state governments should they assume programs formerly financed and administered by the federal goverment. Impact on the federal system brought about by such change could be highly significant. The federal government would be relieved of providing many goods and services. The traditional legal relationship between state and local governments would be renewed. On the matter of state-local relationships Susannah Calkins and John Shannon state, "As the states assume the enhanced role prompted by the current Administration, cities and other local governments will pay less attention to Washington and more to their state capitols." [33]

Another basic objective of the Reagan Administration which could have an impact on the federal system is the cut in federal spending. More particularly, federal aid to state and local governments has been described as "most vulnerable to cutbacks". The cutbacks will result in an enlarged role for state governments within the intergovernmental system as they grapple with problems of what to do about fewer federal dollars. Regardless how they choose to deal with such problems, it is evident that recently established agencies like DCAs can play a vital role in assisting state governments to make more efficient use of the limited available reresources.

To compensate for cuts in federal dollars and to foster the principle behind New Federalism, the Reagan Administration is also advocating that a greater percentage of federal aid be in the form of block grants. These

grants allow state governments more discretion in how federal money is spent (as opposed to categorical grants which have been used so extensively in the past). Consequently, this form of financial assistance serves to enlarge the role of state governments within the federal system as well as strengthen and reinforce traditional state-local ties. On this matter David B. Walker, Albert J. Richter and Cynthia Cates Colella contend, "With respect to the impact on state-local relation, the strong state orientation of the new blocks expands the state role and reduces somewhat the local role in the overall federal grant system."[34] Additional support is provided by Calkins and Shannon who state:

> Cutbacks in grant-in-aid programs and the trend toward block grants instead of a multitude of narrow cagtegorical grants have pushed the states into assuming a more important role in the intergovernmental scene. Not only are the states compelled to be less dependent upon Washington for financing, but the transfer of a number of categorical programs to block grants and the Administration's efforts to relax federal mandates and release federal 'strings' give the states increased freedom and greater responsibility to manage their own affairs and those of their political subdivisions.[35]

Finally, Jean Lawson and Carl W. Sternberg state:

> On the other side of the coin, supporters of the Administration's proposals point out that by designating the states as prime recipients, the block grants are helping to reestablish and reinforce traditional state-local ties. This new partnership should promote greater state understanding of and sensitivity to local problems – a development recently underscored by the outreach efforts of some states and local public interest groups.[36]

Need to restore balance to the intergovernmental system by imposing greater responsibility on state governments has never seemed more apparent than at the present time. Efforts of the Reagan Administration to restructure the intergovernmental system through the New Federalism program with related goals (cuts in federal spending and block grants), if successful, undoubtedly should result in state governments developing a greater concern for the well-being of local governments. Thus, DCAs can become important agencies for assisting states in meeting challenges and changes posed by the 1980s.

CONCLUSIONS

During the 1960s and 1970s accelerating changes in governmental structures, processes, and powers impacted hard upon intergovernmental relations in the United States. The change may be even greater during the 1980s for our federal system. One promising new structure to accommodate changes on the intergovernmental scene was the department of community affairs. Although the new structure went by many different names, differed in power and responsibilities, performed a diversity of functions within the states, and was located in various places within the executive

branch of state governments, it is still a structure of great potential importance. The mechanism is in place whereby states may responsibly address problems of their local government. Whether this occurs depends upon national, state, and local politics. However, this much is certain: problems of our communities demand more attention than ever before in history.

State departments of community affairs may not produce the heavenly city, but their potential contribution to self-government during the '80s may be great indeed, given realistic, enlightened political leadership at the different levels of government. Departments of Community Affairs cannot immediately supplant the myriad of traditional, functional relationships which have grown between departments of state governments and their counterparts in local government. Traditional relationships evolved to provide supervisory needs, and have their own power base. However, new DCAs in the 50 states, with appropriate powers, may provide a degree of coordination previously lacking in state-local relations, and it is in this vein that the future role of DCAs appears most promising.

FOOTNOTES

[1] Advisory Commission in Intergovernmental Relations, *State and Local Roles in the Federal System*, (Washington, D.C.: November, 1981), p. 35.

[2] Revenue sharing simply served to reinforce and foster the relationship between federal-local governments. Two-thirds of the money allocated for revenue sharing went directly to local governments.

[3] In 1980 general revenue sharing constituted 7.6 % of the federal aid to state and local governments while broad based grants made up 11.5%; the remaining 80.9% categorical grants. *Special Analyses, Budget of the United States Government, Fiscal Year 1982*, Executive Office of the President, Office of Management and Budget.

[4] *US News and World Report*, March 24, 1969, p. 30.

[5] Claude Barfield, *Rethinking Federalism*, American Enterprise Institute for Public Policy Research (Washington: 1981), p. 21.

[6] Tax Foundation Inc., *Monthly Tax Features*, Vol. 13, No. 10, (New York: Tax Foundation, November, 1969), p. 1.

[7] National Governors' Conference, *Utilization of Federal Assistance for a Unified State Urban Affairs Program*, (Washington: National Governors' Conference, November, 1967), p. 2.

[8] National Governors' Conference, *The State and Urban Problems*, A Staff Study for the Committee on State-Urban Relations of the National Governors' Conference, October, 1967, pp. 136-137.

[9]It is the opinion of some experts that reapportionment has had no "real" impact on urban problems because of the new coalition that emerged in state legislatures, namely, rural and suburban interests v. urban interests.

[10]Page L. Ingram, "New Roles for the State", *Public Management*, June, 1968, p. 139.

[11]*The States and Urban Problems, op. cit.*, p. 131.

[12]*Ibid.*, p. 132.

[13]*Ibid.*, p. 133.

[14]*Ibid.*. p. 133.

[15]National Governors; Conference, *Utilization of Federal Assistance for a Unified State Urban Affairs Program, op. cit.*, pp. 1-16.

[16]*Ibid.*, p. 11.

[17]"National Policy for the Urban Crisis", *Resources*, No. 33, (Resources for the Furure, January, 1970), p. 23.

[18]A major impetus for additional states to provide for DCAs was the passage of the 1974 Housing and Community Development Act. As reported in *The Book of States 1976-77*, p. 447: "With the new demands placed upon local governments by the 1974 federal act to devise community development programs, housing assistance plans and land use plans, the assistance and coordination programs of community affairs agencies became important components of effective community development."

[19]The federal assistance programs which advocated creation of DCAs uniformly recognized the role of the governor as coordinator of federal, state and local assistance programs.

[20]Advisory Commission on Intergovernmental Relations, *State-Local Relations Bodies: State ACIRS and Other Approaches*, (Washington, D.C.: March, 1981), p. 47.

[21]*Ibid.*, p. 40.

[22]The Council of State Covernments, *The Book of States 1978-79*, p. 600. The statistics are based on a survey conducted by COSCAA; 47 states responded.

[23]*Ibid.*, p. 593. Consult this source for a detailed list of 17 specific functions of DCAs and an example of states for each of the three categories.

[24]National Gevenors' Conference, *The States and Urban Problems, op. cit.*, p. 137.

[25]The Council of State Governments, *The Book of States 1978-79*, p. 596.

[26]*Ibid.*, p. 597.

[27]*Ibid.*, p. 597.

[28]The Council of State Governments, *The Book of States 1980-81*, p. 617.

[29]Jane F. Roberts, "Fiscal Issues Dominate As States Meet the Eighties", *Intergovernmental Perspective*, Winter 1981, Vol., 7, No. 1, p. 23.

[30]*The Book of States 1978-79, op. cit.*, p. 598.

[31]*Ibid.*, p. 598.

[32]*Ibid.*, p. 599.

[33]Susannah Calkins and John Shannon, "The New Formula for Fiscal Federalism: Austerity Equals Decentralization", *Intergovernmental Perspective*, Winter 1982, Vol. 8, No. 1, p. 28.

[34]David B. Walker, Albert J. Richter, and Cynthia Cates Colella, "The First Ten Months: Grant-in-Aid, Regulatory, and Other Changes", *Intergovernmental Perspective*, Winter 1982, Vol. 8, No. 1, p. 12.

[35]Calkins and Shannon, *op. cit.*, p. 28.

[36]Jean Lawson and Carl W. Stenberg, "Rebalanced Federalism: The States' Role and Response", *Intergovernmental Perspective*, Winter 1982, Vol. 8, No. 1, p. 41.

EMBRYONIC CHICK SKELETAL MUSCLE NUCLEI. I. PURIFICATION,
RNA POLYMERASE DISTRIBUTION AND RNA SYNTHESIS[1,2]

Ronald B. Young
Department of Biological Sciences
University of Alabama
Huntsville, AL 35899
and
Peter B. Blauwiekel
Department of Animal Science
Michigan State University
East Lansing, MI 48824

ABSTRACT

Nuclei purified from the leg muscle of 15-day chicken embryos were
capable of incorporating [^{3}H]UTP into RNA for 1.5 hr; synthesis was linear
for approximately 1 hr. A maximum RNA synthesis rate of 15 pmol RNA/hr/µg
DNA was observed when reactions were conducted under optimum conditions of
4 mM Mg^{2+}, 0.5 mM Mn^{2+}, and 125 mM K^+. Nuclear RNA synthesis was DNA-
dependent, and transcript size ranged from 4-40 S. By conducting RNA syn-
thesis in the presence of varied levels of α-amanitin, it was determined
that RNA polymerases I, II, and III contributed 14.7%, 82.8%, and 2.5%,
respectively, of nuclear RNA synthesis. In seperate experiments in which
muscle cell cultures were labeled with [^{3}H]Urd, it was found that RNA
polymerase II products (i.e., polyadenylated RNA) accounted for 18.6% of
the RNA that was transported to the cytoplasm of muscle cells.

INTRODUCTION

Unlike nuclei from most cell types, nuclei from terminally differen-
tiated muscle cells are not capable of DNA replication. These postmitotic
nuclei therefore have synthetic requirements unlike those of continuously
replicating cells, as well as a unique pattern of gene activity. More-
over, transcription in muscle cells may be partially regulated by either
the direct by-products of contraction, or by unique intracellular condi-
tions caused by the contractile event (2, 15-17, 24). For these reasons,
our goal is to understand the regulatory mechanisms of muscle-specific
gene transcription.

The approach that has been chosen for the problem is to study *in
vitro* transcription in isolated embryonic chick skeletal muscle nuclei.
This choice was made because the *in vitro* environment can be controlled
for biochemical measurements and because chromatin is maintained in its

native nuclear environment. Additionally, cell-free nuclear RNA synthesis has been partially characterized in nuclei from a variety of other tissues (4-6, 9, 10, 12, 19, 22, 27), and the fidelity of these systems is considerably higher than in isolated chromatin systems which usually employ high concentrations of exogenous RNA polymerase, usually *E. coli* RNA polymerase (14, 22).

As a first step toward understanding transcriptional regulation in skeletal muscle nuclei, the present study was carried out with four specific goals in mind: (1) to develop a simple procedure for preparation of large quantities of purified embryonic skeletal muscle nuclei, (2) to define optimum *in vitro* conditions for transcription, (3) to define the relative contributions to RNA synthesis of RNA polymerases I, II, and III, and (4) to assess whether the maximally optimized *in vitro* RNA transcription rate in purified muscle nuclei was comparable to the maximum RNA synthesis rate observed in living muscle cells.

MATERIALS AND METHODS

Isolation of Nuclei. Legs from 20 15-day chick embryos were removed, and skin, cartilage and bone were carefully dissected from the muscle tissue. Even small quantities of residual cartilage caused homogenization to be difficult. The tissue was then placed in 28 ml of a solution of 0.32 M sucrose and 3 mM $MgCl_2$. Homogenization was carried out in four batches in a 15 ml Dounce-type homogenizer (Wheaton Scientific Div., Wheaton Industries, Millville, NJ) with 5 strokes of a loosely-fitting pestle. The homogenate was centrifuged for 10 min at 800 x g, the supernatant was discarded, and the pellet was resuspended in 2.4 M sucrose and 1 mM $MgCl_2$ to a final sucrose concentration of 2.2 M. Purified nuclei were sedimented by centrifugation at 85,000 x g for 1 hr in a Beckman SW28 swinging bucket rotor, and the nuclear pellet was resuspended in 50 mM Tris-HCl, pH 8.0, 2.6% purified bovine serum albumin, 25% glycerol, and 5 mM $Mg(OAc)_2$. This nuclear suspension was frozen in a dry ice-ethanol mixture and stored at -70°C. All operations were carried out at 2°C unless otherwise indicated. Normally, 6-11 mg of DNA were recovered from the leg muscle of 20 embryos. DNA content of nuclear preparations was determined by reaction with diphenylamine (8).

RNA Synthesis. Optimum conditions for RNA synthesis by muscle nuclei were similar to those reported by Biswas et al. (5). Reaction mixtures (100 μl, final volume) contained 30 mM Tris-HCl, pH 7.6, 125 mM KCl, 4 mM $MgCl_2$, 0.5 mM $MnCl_2$, 10 mM monothioglycerol, 10 mM creatine phosphate, 100 μg/ml creatine phosphokinase, 10% glycerol, 2.5 mg/ml bovine serum albumin, 1.6 mM ATP, 0.4 mM GTP and CTP, and 0.1 mM [³H]UTP (final specific radioactivity, 1 Ci/mmol). Reactions were initiated by the addition of muscle nuclei to give a final DNA concentration of 200-600 μg/ml, followed by incubation for various times at 25°C in a gently shaking water bath. Aliquots (10 μl) were withdrawn periodically to monitor incorporation of [³H]UMP. [³H]UMP-labeled RNA was precipitated in 5% trichloroacetic acid, collected on Whatman GF/C filters by filtration through a Millipore Sampling Manifold (Millipore Corp., Bedford, MA), washed extensively with 5%

trichlorlacetic acid and processed for scintillation counting as previously described (3).

Analysis of Transcript Size. ^{3}H-labeled RNA transcripts were isolated from nuclei after incubation for 30 min under optimum conditions. Nuclei were first digested with 100 µg/ml of proteinase K at 37°C for 2 hr, and RNA was isolated after extraction of the digest with phenol (2). RNA was recovered by precipitation at -20°C in 67% ethanol, 0.2 M NaOAc, pH 6.0, and the precipitate was collected by centrifugation at 15,000 x g for 15 min and stored at -70°C in water. Density gradient analysis of ^{3}H-labeled RNA was carried out on 5-40% sucrose gradients containing 50% formamide. Centrifugation was at 280,000 x g for 23 hr, and RNA in each fraction was collected on nitrocellulose filters for analysis of radioactivity. Sizes of ^{3}H-labeled transcripts were estimated by centrifugation of ^{3}H-labeled chick ribosomal RNA on parallel gradients. Electrophoretic analysis of nuclear RNA transcripts under nondenaturing conditions was carried out on 2.5% polyacrylamide, 0.5% agarose composite gels (20). Radioactivity was measured in 1 mm gel slices. ^{3}H-labeled chick ribosomal RNA electrophoresed on parallel gels served as size markers. Two methods of size analysis were carried out because larger transcripts were more easily displayed on sucrose gradients, whereas lower molecular weight transcripts were best resolved on agarose-polyacrylamide composite gels.

Analysis of RNA Synthesis in Muscle Cell Cultures. Muscle cell cultures were prepared from 12-day chick embryos as previously reported (25, 26). RNA was isolated from cell cultures following a 2 hr pulse with 40 µCi/ml [3H]Urd. Cultures were rinsed twice with an isotonic saline solution, scraped from the surface, homogenized 20 times with a Dounce homogenizer, and centrifuged at 12,000 x g for 10 min. RNA was isolated from the homogenate by digestion with proteinase K and precipitation with ethanol. Polyadenylated RNA was isolated in a batch process essentially as described by Singer and Kessler-Icekson (21), except that type 3 oligo(dT)-cellulose was employed and two complete cycles of binding were carried out. Labeled RNA was collected on nitrocellulose filters for analysis of radioactivity. Since muscle cell cultures are normally contaminated with 20-30% fibroblasts, RNA synthesis was also measured in separate fibroblast cultures. The contribution of fibroblasts to RNA synthesis rates in muscle cell cultures was then subtracted. DNA content of cultures was measured to allow normalization of RNA synthesis rates among replicate experiments and to permit comparison of these data with nuclear transcription rates.

RESULTS

Nuclei isolated from 15-day embryonic chick leg muscle were pure as judged by phase-contrast microscopy (Fig. 1) and by a protein:DNA ratio of 3.37 ± 0.24 (7). Incorporation of [3H]UTP into RNA was linear for almost 1 hr, with a substantial increase beyond that time (Fig. 2a). Broad, but reproducible, optima for KCl, Mg^{2+}, and Mn^{2+} were observed (Fig, 2b, c, d). Assuming UMP makes up 25% of the RNA polymer, the maximum RNA synthesis rate was calculated to be approximately 15 pmoles/hr/µg DNA. Actinomycin D (10 µg/ml) inhibited 99% of RNA synthesis.
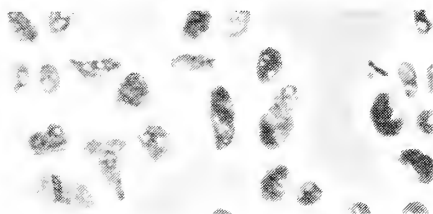
Figure 1. Phase contrast micrograph of nuclei purified from the leg muscle of 15-day chick embryos. X400.
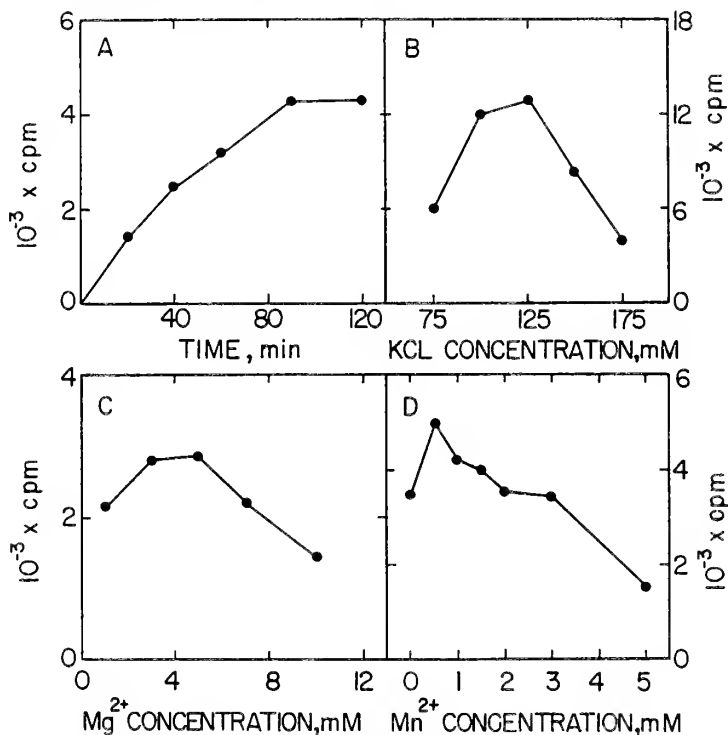
Figure 2. Time course of RNA synthesis and optimization of KCl, $MgCl_2$, and $MnCl_2$ in *in vitro* incubations containing skeletal muscle nuclei. A. Time course of $[^3H]UTP$ incorporation into acid insoluble material. Incubation for the times indicated was in the optimized assay detailed in Materials and Methods. B. Effect of differing levels of KCl on incorporation of $[^3H]UTP$ into RNA. C. Effect of differing levels of $MgCl_2$ on RNA synthesis. D. Effect of $MnCl_2$ on RNA synthesis by muscle nuclei in the presence of 125 mM KCl and 4mM $MgCl_2$. In panels B-D, incubations were for 40 min. In all cases, triplicate samples were taken for each point. Additionally, a background value of approximately 600 cpm after zero min of incorporation was subtracted from each experimental value.

RNA product size ranged from about 4 S to greater than 40 S under denaturing and nondenaturing conditions (Fig. 3). Consistent with previously reported data (9, 22), most of the newly synthesized RNA sedimented at approximately 4-6 S.
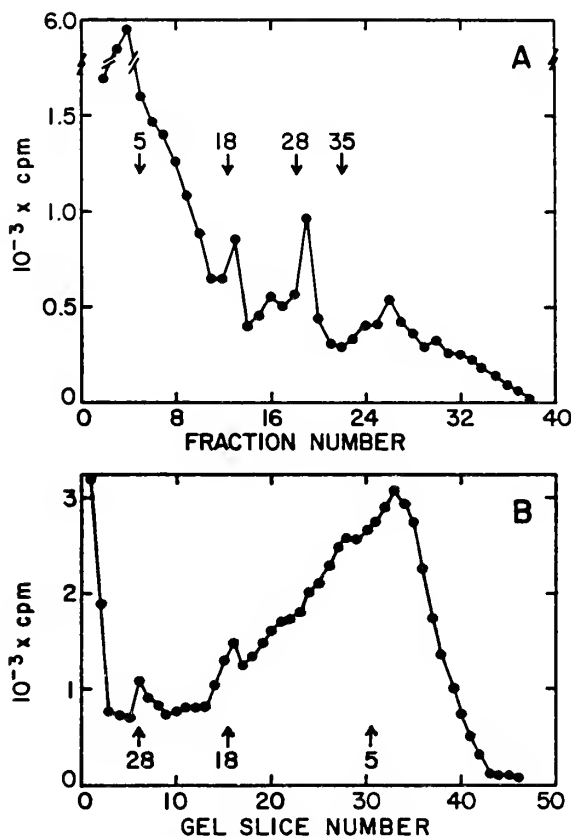
Figure 3. Size of ^{3}H-labeled transcripts synthesized by purified muscle nuclei in the presence of [^{3}H]UTP. Nuclei were incubated for 30 min. in the incubation mixture described in Materials and Methods. A. Centrifugation of ^{3}H-labeled RNA on 5-40% sucrose gradients containing 50% formamide. Arrows and numbers indicate the positions and S-values of ^{3}H-labeled marker RNAs that were centrifuged on parallel gradients. Direction of centrifugation was from left to right. B. Electrophoresis of nuclear transcripts on 2.25% polyacrylamide, 0.5% agarose composite disc gels. Arrows and numbers indicate the positions and S-values of ^{3}H-labeled marker RNAs that were electrophoresed on parallel gels. Direction of migration during electrophoresis was from left to right.

Transcriptionally active muscle nuclei contain three major RNA polymerase species. Since RNA polymerase II primarily transcribes the genes for mRNA, and since RNA polymerase II products are therefore of most interest in studying transcriptional specificity, the relative contributions of the three major polymerases to the total RNA complement synthesized by muscle nuclei was determined. This was accomplished by taking advantage of the differential sensitivity of the three polymerases to the toxin, α-amanitin (23). Results from a typical α-amanitin titration experiment (Fig. 4) illustrate that 0.5 μg α-amanitin/ml inhibited incorporation by 82.8% ± 1.1%. The majority of RNA synthetic activity can therefore be attributed to RNA polymerase II. Polymerase III accounted for 2.5 ± 0.4% of the incorporation, while RNA polymerase I contributed 14.7 ± 1.3% (Fig. 4).

One of the precautions necessary when studying purified muscle nuclei *in vitro* is to determine whether the observed rates of *in vitro* RNA synthesis are quantitatively meaningful. Although the observed optimum rate of 15 pmol RNA/hr/μg DNA was comparable to other reported values (11), the possibility that all *in vitro* rates were unrealistically lower than the true *in vivo* rate had not been evaluated to our knowledge. To evaluate this aspect of *in vitro* transcription, the following approach was taken.
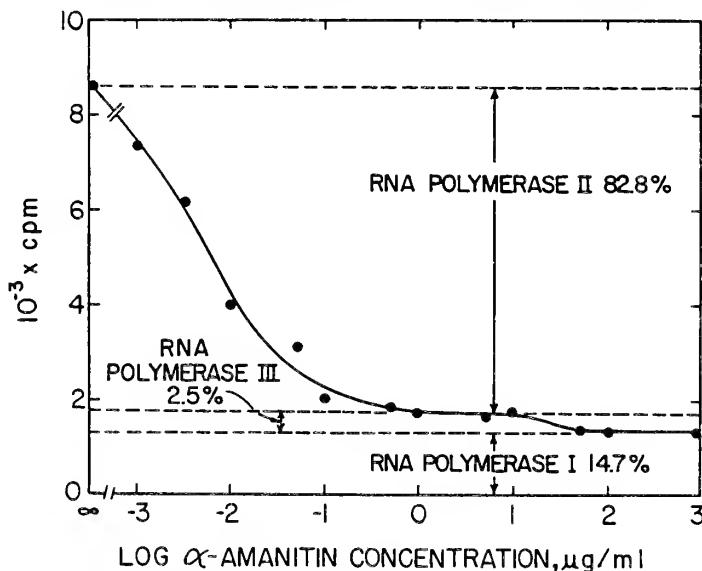
Figure 4. Effect of α-amanitin concentration on incorporation of [^{3}H]UTP into RNA by nuclei purified from embryonic skeletal muscle. Samples at all concentrations of α-amanitin were icubated for 40 min under the optimum conditions detailed in Materials and Methods. All measurements were made in quadruplicate, and a zero-time incubation control sample of 600 cpm was subtracted from the total incorporation by each sample.

The relative appearance or transport rates of RNA polymerase products into the cytoplasm of muscle cells was measured by pulse-labeling muscle cell cultures with [^{3}H]Urd, followed by separation of cytoplasmic RNA into poly(A)-containing and poly(A)-free fractions by oligo(dT)-cellulose chromatography as described in Materials and Methods. RNA synthesis rate and RNA distribution of coding and noncoding RNA fractions in muscle cultures are shown in the first two lines of Table 1.

Virtually all hnRNA is synthesized by RNA polymerase II, and hnRNA is the nuclear precursor to cytoplasmic mRNA, at least 90% of which is poly-adenylated in muscle cells (28). The assumption was therefore made that RNA polymerase II was responsible for virtually all polyadenylated RNA appearing in the cytoplasm. Since most mRNA in muscle cultures contains a 3' poly(A) sequence (28), the polyadenylated and non-polyadenylated fractions should approximate RNA polymerase II products and RNA polymerase I and III products, respectively. Nuclear RNA synthesis rates and percentage distribution are shown in the last two lines of Table 1.

Approximately 18% of the RNA in the cytoplasm contained poly(A) following a 2 hr pulse label, whereas polymerase II products predominated (82.8%) in the nuclear transcription system (Table 1). Thus, most of nuclear RNA polymerase II transcripts never reach the cytoplasm as poly(A)-containing RNA. The polymerase I and III products, on the other hand, made up only 17.2% of nuclear transcripts but 81.4% of cytoplasmic RNA. These results are consistent with the knowledge that hnRNA undergoes more

Table 1. Comparison of RNA polymerase distribution and RNA synthesis rates between purified muscle nuclei and muscle cell cultures.*

Muscle Cell Compartment	RNA Fraction*	% of Total RNA Synthesis Rate Composed by Each Fraction	RNA Synthesis Rate, pmol/ hr/μg DNA
Cytoplasmic	Poly(A)$^+$ RNA	18.6 ± 2.4	3.8
	Poly(A)$^-$ RNA	81.4 ± 2.4	16.8
Nuclear	Polymerase II Products	82.8 ± 1.1	12.4
	Polymerase I + III Products	17.2 ± 1.8	2.6

*RNA synthesis in muscle cultures was assessed by pulse labeling with [^{3}H]Urd, and the ability of [^{3}H]-labeled RNA to bind to oligo(dT)-cellulose was employed to separate poly(A)-containing RNA and non-polyadenylated RNA. Nuclear RNA synthesis rates were determined by *in vitro* incubation in the presence of [^{3}H]UTP, with discrimination between polymerase II and polymerase I + III acheived with α-amanitin.

extensive processing and nuclear restriction than rRNA and tRNA precursors (1, 13, 18). Additionally, the synthesis rate of RNA polymerase II products by nuclei (12.4 pmol/hr/µg DNA) is 3.3-fold higher than the cytoplasmic appearance rate of poly(A)-containing RNA (3.8 pmol/hr/µg DNA).

Although it is obvious from the data in Table 1 that hnRNA undergoes extensive processing prior to transport of mRNA to the cytoplasm, some of the quantitative aspects of nuclear RNA synthesis are less definitive. For example, even though the transcription rate in nuclei must be substantially greater than the rate of RNA transport to the cytoplasm (because of extensive RNA processing), Table 1 shows that these independently measured rates are not drastically different (i.e., 20.6 versus 15.0 pmol RNA/hr/µg DNA for total cytoplasmic and total nuclear RNA synthesis, respectively). Additionally, the synthesis rate of noncoding RNA in the nuclear assay (2.6 pmol/hr/µg DNA) is several-fold less than the observed cytoplasmic appearance rate of 16.8 pmol/hr/µg DNA. Whether these diminished RNA synthesis rates by muscle nuclei result from a drastically inadequate incubation mixture, or whether they result from an inordinately severe nuclear isolation procedure that inactivates a major fraction of the nuclei, is not yet known.

DISCUSSION

The purity of embryonic muscle nuclei, as judged by phase-contrast microscopy and protein:DNA ratio is similar to that reported elsewhere (7). The general salt requirements for RNA transcription in muscle nuclei are similar to those reported in other systems (5, 11). The absolute rate of RNA synthesis in muscle nuclei observed in this study was in the middle range of values reported for other systems (2-25 pmol RNA/hr/µg DNA). RNA products up to 50 S in size were observed with most material sedimenting between 4 and 6 S. Some discrete peaks were usually observed, especially at 18 S and 28 S, but these were not always reproducible.

RNA polymerase I, II, and III accounted for 14.7%, 82.8%, and 2.5%, respectively, of the RNA synthesis measured in muscle nuclei. These percentages are significantly different from those reported for stationary GR cells (23). GR cells originate from a mammary carcinoma of rats, and RNA polymerases I, II and, III account for 47%, 46%, and 7%, respectively, of total RNA synthesis (23). Therefore, a considerably higher proportion of RNA polymerase is engaged in mRNA synthesis in post-mitotic muscle nuclei than in nuclei from nondividing GR cells. Although RNA polymerase II is responsible for approximately 80% of nuclear RNA synthesis in muscle nuclei, the percentage of poly(A)-containing RNA (which is formed by processing of hnRNA) is much lower (Table 1). Moreover, the finding that total cellular RNA species are much more diverse than polysomal RNA is further evidence of nuclear restrictions or degradation (13). Finally, the values reported here for RNA synthesis in both muscle nuclei and muscle cell cultures are minimum estimates because of the inherent assumption that unlabeled UMP released from RNA degradation during the labeling period does not significantly lower the specific radioactivity of the exogenous ^{3}H-labeled precursor. This potential error is likely to be more significant

in muscle cell cultures than in purified muscle nuclei, making the dispar-
ity between the two measurements even greater than suggested by the data
in Table 1.

Collectively, the data shown here illustrate that qualitative aspects
of gene expression are retained by muscle nuclei, but optimally active
nuclei are several-fold less active *in vitro* than *in vivo*.

LITERATURE CITED

1. Abelson, J. 1979. RNA processing and the intervening sequence prob-
    lem. Ann. Rev. Biochem. 48, 1035-1069.
2. Aviv, H. and P. Leder. 1972. Purification of biologically active
    globin messenger RNA by chromatography on oligothymidylic acid-cellu-
    lose. Proc. Natl. Acad. Sci. USA 69, 1408-1412.
3. Birnboin, H.C. 1970. Optimal conditions for counting of precipitated
    ^{3}H-RNA on glass-fiber filters. Anal. Biochem. 37, 178-182.
4. Biswas, D.K. 1978. RNA-protein interactions in a cell-free system
    with isolated nuclei from GH_3 cells. Biochem. 17, 1131-1136.
5. Biswas, D.K., T.F.J. Martin and A.H. Tashjian. 1976. Extended RNA
    synthesis in isolated nuclei from rat pituitary tumor cells. Bio-
    chem. 15, 3270-3280.
6. Cooper, D.L. and W.F. Marzluff. 1978. Polyadenylation of RNA in a
    cell-free system from mouse myeloma cells. J. Biol. Chem. 253,
    8375-8380.
7. David, J.D., R.L. Fredrickson and G.L. Peterson. 1978. Isolation and
    purification of myotube and myoblast nuclei from cultures of embryon-
    ic chick skeletal muscle. Exptl. Cell Res. 117, 63-70.
8. Dische, Z. 1955. Color of nucleic acid components. *In* The Nucleic
    Acids. E. Chargaff and J.N. Davidson, editors. Academic Press, Inc.
    1, 287-290.
9. Ernest, M.J., G. Schutz and P. Feigelson. 1976. RNA synthesis in
    isolated hen oviduct nuclei. Biochem. 15, 824-829.
10. Gilboa, E., H. Soreq and H. Aviv. 1977. Initiation of RNA synthesis
    in isolated nuclei. Eur. J. Biochem. 77, 393-400.
11. Gross, R.H. and J. Ringler. 1979. Ribonucleic acid synthesis in iso-
    lated *Drosophila* nuclei. Biochem. 18, 4923-4927.
12. Held, I.R. 1978. Stimulation of nuclear RNA synthesis in denervated
    skeletal muscles. J. Neurochem. 30, 1239-1243.
13. Herman, R.C., J.G. Williams and S. Penman. 1976. Message and non-
    message sequences adjacent to poly(A) in steady-state heterogeneous
    nuclear RNA of HeLa cells. Cell 7, 429-437.
14. Honjo, T. and R.W. Reeder. 1974. Transcription of *Xenopus* chromatin
    by homologous RNA polymerase: Aberrant synthesis of ribosomal and 5
    S RNA. Biochem. 13, 1896-1899.
15. Ingwall, J.S., M.F. Morales and F.E. Stockdale. 1972. Creatine and
    the control of myosin synthesis in differentiation of skeletal mus-
    cle. Proc. Natl. Acad. Sci. USA 69, 2250-2254.
16. Ingwall, J.S., C.D. Weiner, M.F. Morales, E. David and F.E. Stock-
    dale. 1974. Specificity of creatine in the control of muscle protein
    synthesis. J. Cell Biol. 62, 145-151.

17. Ingwall, J.S. and K. Wildenthal. 1976. Role of creatine in the regulation of cardiac protein synthesis. J. Cell Biol. 68, 159a.
18. Lewin, B. 1975. Units of transcription and translation. The relationship between heterogenous nuclear RNA and mRNA. Cell 4, 11-20.
19. Orkin, S.H. 1978. Fidelity of globin ribonucleic acid synthesis *in vitro* by isolated nuclei. Biochem. 17, 487-492.
20. Peacock, A.C. and C.W. Dingman. 1968. Molecular weight estimation and separation of RNA by electrophoresis in agarose-acrylamide composite gels. Biochem. 7, 668-674.
21. Singer, R.H. and G. Kessler-Icekson. 1978. Stability of polyadenylated RNA in differentiating myogenic cells. Eur. J. Biochem. 88, 395-402.
22. Smith. M.M. and R.C.C. Huang. 1976. Transcription *in vitro* of immunoglobulin kappa light chain genes in isolated mouse myeloma nuclei and chromatin. Proc. Natl. Acad. Sci. USA 73, 775-779.
23. Stallcup, M.R., J. Ring and K.R. Yamamoto. 1978. Synthesis of mouse mammary tumor virus RNA in isolated nuclei from cultured mammary tumor cells. Biochem. 17, 1515-1521.
24. Young, R.B. and R.E. Allen. 1979. Transitions in gene activity during development of muscle fibers. J. Anim. Sci. 48, 837-852.
25. Young, R.B., W.G. Bergen and P.B. Blauwiekel. 1979. Myosin synthesis in embryonic chicken fibroblasts. J. Cell Biol. 81, 115-122.
26. Young, R.B., D.E. Goll and M.H. Stromer. 1975. Isolation of myosin synthesizing polysomes from cultures of embryonic chicken myoblasts before fusion. Develop. Biol. 47, 123-135.
27. Zimmer, S.G., C.J. Goldenberg, D.P. Carlson, E.A. Craig and H.J. Raskas. 1978. Size distribution of polyadenylated adenovirus 2 RNA synthesized in isolated nuclei. Biochem. 17, 4207-4213.
28. Paterson, B.M., B.E. Roberts and D. Yaffe. 1974. Determination of actin messenger RNA in cultures of differentiating embryonic chick skeletal muscle. Proc. Natl. Acad. Sci. USA 71, 4467-4471.

EMBRYONIC CHICK SKELETAL MUSCLE NUCLEI. II. FIDELITY
AND TISSUE-SPECIFICITY OF NASCENT
RNA TRANSCRIPTION[1,2]

Ronald B. Young
Department of Biological Sciences
University of Alabama
Huntsville, AL 35899
and
Peter B. Blauwiekel
Department of Animal Science
Michigan State University
East Lansing, MI 48824

ABSTRACT

Nascent nuclear RNA transcripts purified from embryonic chick skeletal muscle nuclei were examined for fidelity of transcription and muscle tissue specificity. Nuclei were incubated in an optimized *in vitro* transcription system in which CTP had been replaced by an equimolar amount of 5-mercuri-CTP (HgCTP). Newly synthesized nascent RNA transcripts, which contained HgCMP in their primary structure, were fractionated from the excess of endogenous nuclear RNA by affinity chromatography over sulfydryl-agarose. HgCTP did not markedly affect transcription rate, transcript size, or the distribution of activity among RNA polymerases I, II, and III. Additionally, the nucleotide analogue did not induce fortuitous crosslinking of Hg-labeled RNA with unlabeled endogenous nuclear RNA or loss of transcriptional fidelity. Tests for retention of tissue-specificity by purified nascent transcripts were carried out by comparing the ability of an α-actin cDNA clone and myosin heavy chain cDNA to hybridize to northern blots containing nascent RNA preparations from embryonic chick skeletal muscle nuclei and embryonic chick liver nuclei. Muscle-specific probes hybridized more extensively with muscle nascent transcripts than with liver nascent transcripts. These data illustrate that *in vitro* nascent RNA transcription occurs with sufficient fidelity and specificity to warrant the use of purified nuclei in studies on control of transcription in muscle cells.

INTRODUCTION

The transcription event includes the major processes of initiation of new RNA chains, elongation of nascent RNA chains and termination. Clearly, tissue-specific transcription is more likely to be regulated at initiation than at nascent chain elongation or termination. However, it is

231

first necessary to demonstrate that the nuclear isolation procedure has not altered the capability of purified nuclei to complete their complement of nascent RNA without loss of tissue-specificity. Since nascent RNA chains are a direct and immediate reflection of gene activity in muscle tissue, the objectives of the present study were as follows: (1) to purify nascent RNA transcripts from muscle nuclei by incorporation of mercurated nucleotides and subsequent fractionation by SH-agarose chromatography, (2) to determine whether *in vitro* nascent chain completion occurs with fidelity, and (3) to assess the tissue-specificity of purified nascent transcripts. The results of these experiments indicate that nascent RNA chain completion in purified nuclei occurs without loss of fidelity and tissue-specificity.

MATERIALS AND METHODS

Materials. Mercurated CTP (HgCTP) and Agarose-ethane-thiol (SH-agarose) were obtained from P.L. Biochemicals (Milwaukee, WI), and actinmycin D was purchased from Sigma Chemical Company (St. Louis, MO). ^{3}H-labeled and α-^{32}P-labeled nucleoside triphosphates were from either New England Nuclear (Boston, MA) or Amersham (Arlington Heights, IL). Purified α-actin-containing pBR322 clone, pAC269 (11, 12), was a gift of Dr. Robert Schwartz. AMV reverse transcriptase was a generous gift of Dr. J.W. Beard (Life Sciences, Inc., St. Petersburg, FL).

Purification of Muscle Nuclei. Legs from 20 15-day chick embryos were removed, and skin, cartilage, and bone were carefully dissected from the muscle tissue. Nuclei were prepared as described in the companion paper (14).

RNA Synthesis. Optimum conditions for RNA synthesis by muscle nuclei were similar to those reported elsewhere (14). Reaction mixtures (100 μl, final volume) contained 30 mM Tris-HCl, pH 7.6, 125 mM KCl, 4 mM MgCl$_2$, 0.5 mM MnCl$_2$, 10 mM monothioglycerol, 10 mM creatine phosphate, 100 μg/ml creatine phosphokinase, 10% glycerol, 2.5 mg/ml bovine serum albumin, 1.6 mM ATP, 0.4 mM GTP and CTP, and 0.1 mM [^{3}H]UTP (final specific radioactivity, 1 Ci/mmol). When transcripts were to be mercurated, HgCTP was substituted for CTP at the same concentration. Reactions were initiated by the addition of nuclei to give a final DNA concentration of 200-600 μg/ml, followed by incubation for various times at 25°C in a gently shaking water bath. Aliquots (10 μl) were withdrawn periodically to monitor incorporation of [^{3}H]UMP. Labeled RNA was precipitated in 5% trichloroacetic acid, collected on Whatman GF/C filters, washed extensively with 5% trichloroacetic acid and processed for scintillation counting as previously reported (10). When HgRNA transcripts were to be purified, four of the above reaction mixtures of 2 ml each were pooled. This was necessary because of the low absolute yield of purified nascent RNA. In addition, the quantity of [^{3}H]UTP added to the assay mixture was reduced by ten-fold, and exogenous, unlabeled UTP was added to a final concentration of 1 mM. This reduced final specific radioactivity of [^{3}H]UTP still allowed incorporation kinetics to be determined and provided adequate labeling to follow purification of nascent RNA transcripts; however, it was sufficiently low

that it did not interfere with autoradiographic analysis by ^{32}P-labeled probes. Potential interference by the ^{3}H-labeled RNA during autoradiography was further eliminated by wrapping each blot with Saran Wrap prior to autoradiographic exposure, thus preventing the weak beta particles of ^{3}H from penetrating from the blot to the X-ray film.

Analysis of Transcript Size. ^{3}H-lableled RNA transcripts, both mercurated and non-mercurated, were isolated from nuclei after incubation for 30 min under optimum conditions. Nuclei were first digested with 100 µg/ml of proteinase K at 37°C for 2 hr, and RNA was isolated after extraction of the digest with phenol:chloroform (1:1 by volume). RNA was collected by precipitation at -20°C in 67% ethanol and 0.2 M NaOAc, pH 6.0, and the pelleted RNA was stored at -70°C in water. Density gradient analysis of ^{3}H-labeled RNA was carried out on 10-30% sucrose density gradients containing 0.5% NaDodSO$_4$ and 20 mM Tris-HCl, pH 7.4. Centrifugation was at 50,000 rpm for 2.5 hr in a Beckman SW50.1 rotor, and RNA in each fraction was collected on nitrocellulose filters for analysis of radioactivity. Size of ^{3}H-labeled transcripts was estimated by centrifugation of ^{3}H-labeled chick ribosomal RNA on parallel gradients.

Purification of Mercurated Nascent Transcripts. RNA synthesis and isolation were carried out as described above, except that HgCTP was substituted for CTP. SH-agarose columns were equilibrated with 0.1 M NaCl, 0.5% NaDodSO$_4$, and 10 mM Tris-HCl, pH 7.5. Ethanol-precipitated RNA samples were dissolved in 0.5% NaDodSO$_4$ and 10 mM Tris-HCl, pH 7.5, heated at 65°C for 5 min and quickly chilled to 2°C. Samples were applied to an 8 ml column, and the column was rinsed first with 100 ml of the column equilibration buffer and then with 200 ml of the same buffer without NaDodSO$_4$. The Hg-labeled RNA was then eluted with 0.1 M 2-mercaptoethanol and 10 mM Tris-HCl, pH 7.5, and precipitated in 67% ethanol and 0.1 M NaOAc, pH 6.0.

Purification of Polysomal RNA from Muscle and Liver Tissue. Liver tissue and leg muscle tissue from 14-day chick embryos were homogenized in an equal volume of cold (2°) polysome isolation buffer (0.25 M NaCl, 20 mM Tris-HCl, pH 7.4). Tissues were first homogenized with 5 strokes of loosely-fitting pestle in a Dounce homogenizer (Wheaton Scientific Division, Wheaton Industries, Millville, NJ) and then with 5 strokes of a tightly-fitting pestle. The homogenate was centrifuged at 12,000 x g for 10 min, and the supernate was layered onto 5 ml of 1.5 M sucrose, 0.25 M NaCl, 20 mM Tris-HCl, pH 7.4. Polysomes were then collected by centrifugation at 225,000 x g for 2 hr. RNA was purified from muscle and liver polysomal pellets by digestion with 100 µg proteinase K/ml in 0.5% NaDodSO$_4$, extraction two times with a 1:1 (vol:vol) mixture of phenol/chloroform, ethanol precipitation, and chromatography over oligo(dT)-cellulose (type 3). The concentration of the resulting polysomal, polyadenylated RNA was calculated by its absorbance at 260 nm, and storage was at -70°C in distilled water.

Synthesis of Radioactive cDNA and pAC269. The cDNA preparation procedure was patterned after several studies reporting synthesis of full length reverse transcripts (5,7). [^{32}P]dCTP (0.1 mCi, 400 Ci/mmol) was

dried in the reaction tube under a stream of nitrogen gas prior to addition of the other components. The final reaction mixture (0.5 ml) contained the following components: 50 mM Tris-HCl (pH 8.3), 40 mM KCl, 8 mM $MgCl_2$, 0.2 mM TTP, 0.2 mM dATP, 0.2 mM dGTP, 0.2 mM [^{32}P]dCTP, 5 µg/ml oligo(dT)$_{12-18}$, 40 mM dithiothreitol, 5 µg/ml actinomycin D, 0.1 µg/ml myosin heavy chain mRNA, 0.32 units/µl AMV reverse transcriptase. Incubation was at 37°C for 45 min, during which time incorporation into trichloroacetic acid-insoluble polynucleotides increased in a linear fashion. Termination of the reaction was accomplished by the addition of EDTA and $NaDodSO_4$ to final concentrations of 2 mM and 0.05%, respectively. Calf thymus DNA (50 µg) was added as a carrier, and the sample was chromatographed over a 1 x 50 cm BioRad P-30 column that had been previously equilibrated with 0.1 M NaCl, 25 mM EDTA, 20 mM Tris-HCl, pH 7.5. The fractions containing cDNA were pooled and precipitated overnight with 2 volumes of ethanol at -20°C. Nucleic acid was collected by centrifugation at 15,000 x g for 15 min, the pellet was dissolved in 0.1 N NaOH, 10 mM EDTA and heated at 70°C for 1 hr to hydrolyze mRNA, the pH was adjusted to 6.0, and cDNA was precipitated at -20°C in 67% ethanol. The pAC269 actin DNA was nick-translated in the presence of [α-^{32}P]dCTP, using a nick translation kit from New England Nuclear (NEK-004)/ Myosin heavy-chain mRNA was prepared from the leg muscle of 14-day chick embryos as detailed by Heywood et al. (2).

Preparation and Hybridization of Dot Blots. Mercurated nascent transcripts, purified as described earlier, were spotted on BA85 nitrocellulose filters (Schleicher and Schuell, Inc., Keene, NH). The filters were dried, baked *in vacuo*, prehybridized, hybridized with the appropriate probe, rinsed and exposed to X-ray film as detailed by Thomas (13).

Muscle Cell Cultures. Muscle cell cultures were prepared from the leg muscle of 12-day chick embryos as described by Young et al. (16).

<center>RESULTS</center>

Separation of New Transcripts from Endogenous Nuclear Transcripts and Fidelity of RNA Synthesis. Prior to investigating the specificity of mRNA transcription in muscle nuclei, it was critical to quantitatively separate nascent RNA chains from the vast excess of endogenous nuclear RNA synthesized prior to nuclear purification. This was accomplished by incorporating HgCTP in place of CTP during *in vitro* transcription. The Hg-labeled RNA was then bound to SH-agarose and subsequently eluted with mercaptoethanol.

To verify that HgCTP did not induce abnormalities during transcription, numerous preliminary experiments were conducted. The rate of [^3H]-UTP incorporation by muscle nuclei in the presence of HgCTP was typically about 80% of control values (Fig. 1), and the duration of synthesis was indistinguishable from controls. Additionally, actinomycin D completely inhibited RNA synthesis in the presence of HgCTP (Table 1). These data indicate that the nucleotide analogue does not introduce gross aberrations in RNA synthesis, such as single strand terminal addition by RNA polymer-
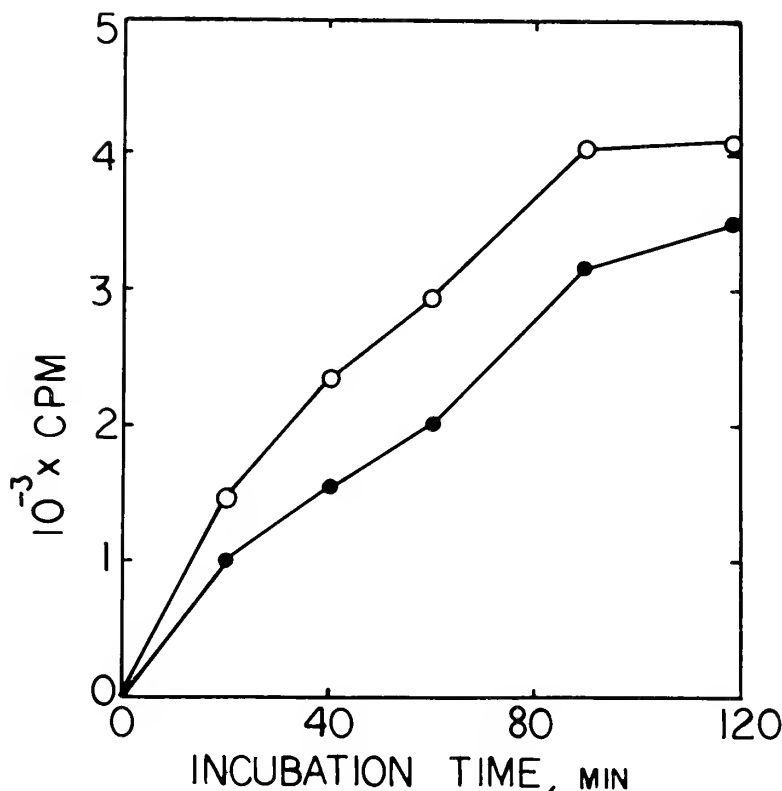
Figure 1. Time course of [^{3}H]UTP incorporation into trichloroacetic acid-insoluble products by muscle nuclei in the presence of CTP (o) and HgCTP (•). Nuclear RNA synthesis was carried out in the optimized assay system described in Materials and Methods. Each point represents the mean of duplicate determination.

ase (17, 18). The distribution of incorporation of [^{3}H]UTP into RNA by RNA polymerases I, II, and III was qualitatively similar in the presence and absence of HgCTP (Table 2), although the slight inhibition of RNA polymerase II resulted in a concomitant increase in the percentage synthesis by RNA polymerases I and III. Finally, the size distribution of Hg-labeled transcription products is qualitatively similar to the size of control products, and RNA species of greater than 30 S are consistently observed during sucrose density gradient centrifugation (Fig. 2).

We also assessed whether non-mercurated endogenous RNA transcripts would nonspecifically adhere to SH-agarose under standard binding-elution conditions and thereby co-purify with Hg-labeled transcripts. For these experiments, muscle cell culturess were labeled with 0.5 μCi/ml of [^{3}H]Urd

Table 1. Effect of Actinomycin D on Nuclear RNA Synthesis by Muscle Nuclei in the Presence and Absence of HgCTP.

Standard Incubation Mixture:	$[^3H]$UMP cpm ($\pm$ SEM)	% Inhibition by Actinomycin D
With no additions	6414 $\pm$ 134	---
With Actinomycin D	29 $\pm$ 26	99.6
Without CTP, with HgCTP	6270 $\pm$ 441	---
Without CTP, with HgCTP, with Actinomycin D	83 $\pm$ 73	98.7

Table 2. Effect of HgCTP on RNA Polymerase Distribution in Embryonic Chick Skeletal Muscle Nuclei.[1]

	Control[2]	+ HgCTP[3]
RNA Polymerase I	14.3 $\pm$ 0.9	16.7 $\pm$ 1.8
RNA Polymerase II	81.3 $\pm$ 0.6	77.0 $\pm$ 2.6
RNA Polymerase III	4.3 $\pm$ 0.9	7.7 $\pm$ 3.1

[1]Percentage of total RNA synthesis contributed by each RNA polymerase was assayed at various concentrations of α-amanitin as described in the accompanying manuscript[14]. Each value represents the mean $\pm$ 1 SEM of four experiments in which all measurements were in triplicate.
[2]Control incubations were for 40 min in the optimized assay described in Materials and Methods.
[3]Reactions were carried out for 40 min in the optimized assay, except that CTP was replaced with an equimolar amount of HgCTP.

for 16 hr to ensure uniform labeling of all RNA species. Total RNA was then extracted from the cultures with phenol/chloroform and chromatographed over SH-agarose as detailed in Materials and Methods. Less than 0.001% of the labeled RNA was eluted upon addition of mercaptoethanol (Fig. 3). For example, in the experiment shown in Fig. 3, approximately 1.2×10^5 cpm were loaded onto the column, and none of the fractions eluting after addition of mercaptoethanol exhibited cpm greater than that of background level. The elution pattern of mercurated nuclear RNA transcripts is also shown in Fig. 3.
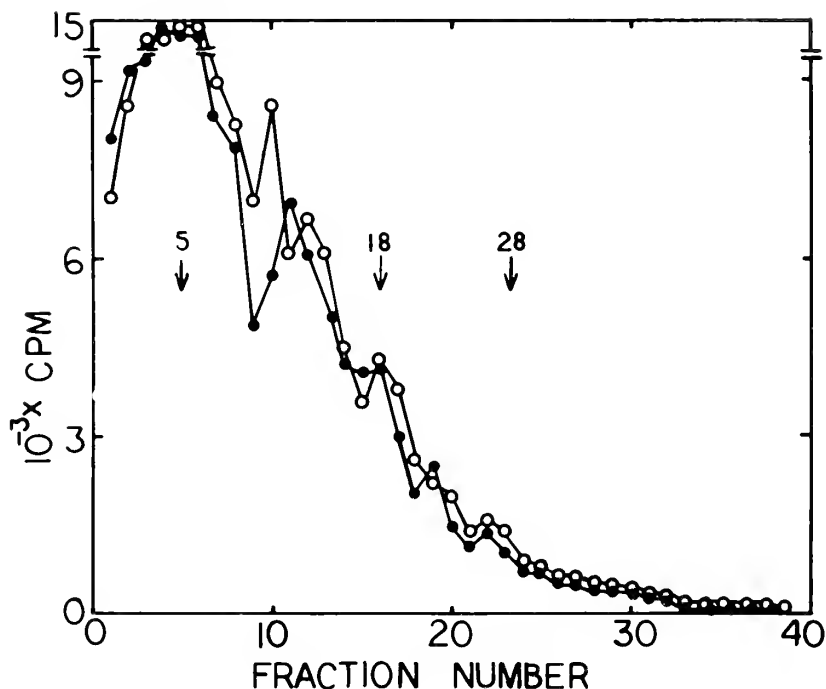
Figure 2. Size distribution of nuclear transcripts from skeletal muscle nuclei. Nuclei were incubated for 90 min in the *in vitro* transcription assay detailed in Materials and Methods in the presence of either CTP (o) or HgCTP (●). RNA was purified and centrifuged on 10-30% sucrose density gradients at 300,000 x g for 2.5 hr. The small arrows and numbers in the figure indicate the positions of chick ribosomal RNA that was centrifuged on parallel gradients.

A key assumption in this study was that nascent RNA chain completion would occur without loss of transcriptional fidelity. That is, the *in vitro* incubation must not cause RNA polymerase to catalyze polymerization by any means other than asymmetric, DNA-directed specific gene transcription. Three potential aberrations in normal RNA transcription could result in fortuitous purification of endogenous transcripts along with newly synthesized RNA during SH-agarose chromatography. The presence of these fortuitous transcripts would artificially inflate the apparent *in vitro* tissue specificity. First, nonspecific terminal addition of mercurinucleotides to endogenous transcripts would cause binding of these transcripts to SH-agarose. Secondly, RNA polymerase might improperly initiate transcription of endogenous RNA transcripts. The resultant anti-sense RNA would contain mercurinucleotides and, more importantly, would have endogenous mRNA transcripts hybridyzed to it. Purification of the anti-sense mRNA by SH-agarose chromatography would therefore result in concomitant

237
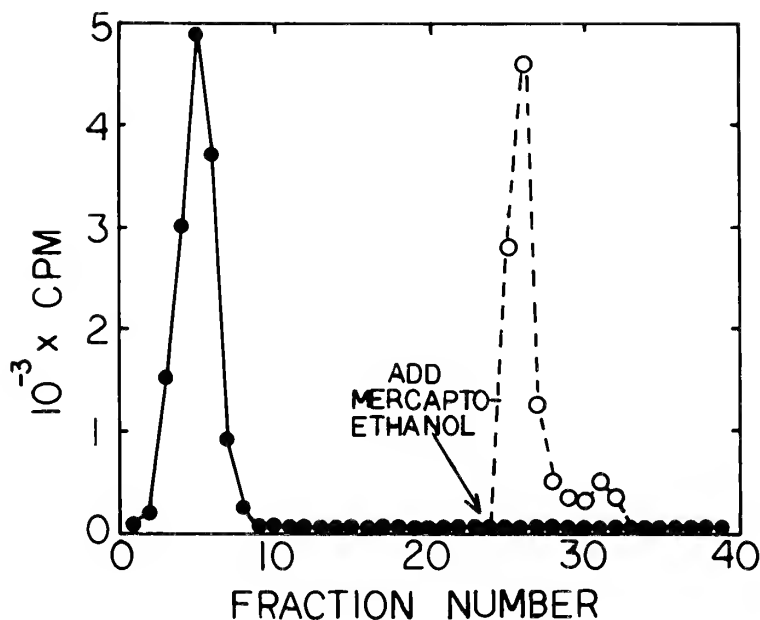
Figure 3. Elution profile on sulfhydryl-agarose (SH-agarose) of mercurat-
ed and nonmercurated RNA. The solid line represents the elution pat-
tern of nonmercurated, ^{3}H-labeled purified from muscle cell cultures.
Cultures were labeled for 16 hr in complete culture medium containing
0.5 μCi/ml of [^{3}H]Urd. None of this material could be detected in
column fractions following the addition of 0.1 M 2-mercaptoethanol.
The dashed line represents a separate experiment in which the elution
pattern of mercurated, [^{3}H]UMP-labeled RNA transcripts purified from
skeletal muscle nuclei was examined. The SH-agarose column was pre-
pared, equilibrated, and processed for each experiment as described
in Materials and Methods.

co-purification on endogenous mRNA. Thirdly, initiation of RNA synthesis
might become nonspecific under the *in vitro* incubation conditions. Thus,
it would be possible that the anti-coding strand of DNA could be non-spe-
cifically transcribed by RNA polymerase. As with the second case above,
the resultant anti-sense mRNA would contain mercurinucleotides in its pri-
mary structure and, additionally, could form a stable hybrid structure
with endogenous mRNA. Purification of this anti-sense mRNA by SH-agarose
chromatography would result in copurification of endogenous mRNA.

Experiments were conducted to eliminate the above possibilities. The
second and third possibilities, which involve formation of stable double
stranded duplexes, are eliminated by destruction of double stranded re-
gions by heat denaturation immediately before elution of the RNA from the

SH-agarose affinity column. Because actinomycin D is a potent inhibitor of double-stranded DNA-directed RNA synthesis, and because the first and second possibilities listed above involve polymerization in the presence of single stranded RNA, neither of these activities would be affected by actinomycin D. That this aberration does not occur is suggested by the fact that actinomycin D inhibits approximately 99% of HgRNA synthesis (Table 1).

The second and third possibilities listed above are potentially the most serious. Additionally, the possibility that Hg could non-specifically crosslink RNA was not addressed by the above experiments. Thus, the following experiments were carried out. Radioactive RNA purified from muscle cultures prelabeled with [^{3}H]Urd was mixed with Hg-labeled RNA purified from muscle nuclei. These mixed samples were then heated and chromatographed over SH-agarose as described earlier. Under these conditions, it would be expected that some of the [^{3}H]RNA would be eluted upon the addition of mercaptoethanol if the second and third aberrations described above were occurring or if Hg causes nonspecific RNA crosslinking. All fractions exhibited background radioactivity upon elution with mercaptoethanol (i.e., the 10 fractions immediately prior to mercaptoethanol contained 28 ± 2 cpm/fraction, whereas the 25 fractions following mercaptoethanol contained 27 ± 3 cpm/fraction). Since greater than 10^6 cpm were initially applied to the column, nonspecific, fortuitous RNA purification could not be greater than 0.01%. Thus, it is concluded that RNA transcriptional fidelity is retained in nuclear assays and that nonspecific RNA crosslinking is absent.

Tissue Specificity of RNA Synthesis. Evidence for retention of muscle specificity by muscle nuclei was derived from analysis of polysomal and nascent nuclear RNA blots by hybridization against ^{32}P-labeled actin and myosin probes. In each case, control experiments with either liver polysomal RNA or liver nascent RNA were conducted simultaneously. Embryonic liver was chosen as the nonmuscle control tissue because liver nuclei and liver polysomal RNA could be conveniently prepared from the same chick embryos as muscle. The ^{32}P-labeled actin-pBR322 plasmid, pAC269, hybridized much more intensely with muscle polysomal RNA than with liver polysomal RNA (Fig. 4A), and it reacted more strongly with muscle nascent RNA transcripts than with liver nascent RNA (Fig. 4B). The presence of detectable hybridization by pAC269 to both liver polysomal and nascent RNA is likely due to synthesis of β- and γ-actin mRNA by liver cells. That the cloned α-actin DNA cross-reacts with β- and γ-actin mRNAs (which have a higher molecular weight than α-actin mRNA) is illustrated in Fig. 5. Finally, ^{32}P-labeled cDNA against myosin heavy chain mRNA also hybridized more intensely to nascent muscle nuclear RNA transcripts than to nascent liver transcripts (Fig. 4C).

DISCUSSION

Prolonged, strenuous contraction in skeletal muscle (e.g., exercise-induced hypertrophy) or prolonged inactivity (e.g., denervation, muscular dystrophy) result in myofibrillar protein accumulation or diminution, respectively (3, 6, 10, 15). However, it is not known how the level of con-

239
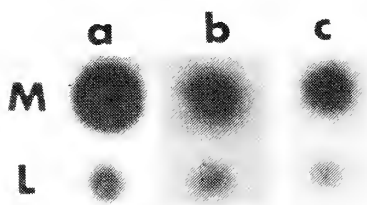
Figure 4. Hybridization analysis of HgRNA isolated from embryonic muscle and liver polysomes or from muscle and liver nuclei. RNA was linked to nitrocellulose paper as described in Materials and Methods. A. Muscle and liver polysomal RNA was analyzed by hybridization against ^{32}P-labeled α-actin clone, pAC269. B. HgRNA from nuclei was analyzed by hybridization against ^{32}P-labeled α-actin clone, pAC269. C. HgRNA from nuclei was analyzed by hybridization against ^{32}P-labeled cDNA to myosin heavy chain mRNA.

Figure 5. Northern blot analysis of RNA isolated from cell cultures of prefusion muscle cells (lane 1) and from fully differentiated muscle cell cultures (lane 2). The blot was analyzed by hybridization against ^{32}P-labeled α-actin clone, pAC269. The upper band in lane 1 is due to expression of β- and γ-actin mRNAs, which have a higher molecular weight than α-actin mRNA.

tractile activity, which is a protein-protein interaction, can indirectly lead to alterations in the accumulated quantity of muscle proteins. It seems unlikely that these extremes in myofibrillar protein content (i.e., disease-induced atrophy versus work-induced hypertrophy) are accomplished without significant quantitative alterations in the rate of myofibrillar mRNA transcription. Consequently, either unique by-products of the contractile event, or perhaps a set of unique cytoplasmic conditions indirectly caused by prolonged contractile activity or pathological states, may interact with the muscle nucleus to activate a signalling mechanism that in turn modulates the quantity of myofibrillar mRNA delivered to the cytoplasm (3, 4, 6, 15).

One way to study the above processes is to follow the incorporation of CTP containing covalently bound mercury atoms into the primary structure of *in vitro* transcripts. As demonstrated in detail by Dale and Ward (1), the physical and chemical properties of mercurated polynucleotides are not significantly altered by the presence of mercury. For example, they function efficiently as templates for nucleic acid polymerases, they are degraded by several nucleolytic enzymes, and they exhibit mormal denaturation and reannealing characteristics if the level of mercuration is kept below approximately 25%. Moreover, the presence of as few as one mercurated nucleotide per 200 bases permits selective, quantitative fractionation by SH-agarose chromatography (1). Although the mercury-carbon bond in 5-Hg-CTP is somewhat themolabile during prolonged hybridizations at elevated temperatures, this potential problem is circumvented in the present experiments where mercury loss can only occur after nascent transcripts have been linked to nitrocellulose paper.

The data presented here indicate that tissue-specificity is retained in purified muscle nuclei; however, it must be emphasized that either cloned messages or purified cDNAs must be employed for detection of tissue-specific gene expression. Our first attempts in this analysis employed cDNA synthesized against poly(A)-containing RNA purified from either embryonic muscle or liver tissue. Hybridization of neither muscle cDNA nor liver cDNA to muscle and liver nuclear RNA preparations showed significant differences in blot experiments such as those shown in Fig. 4 (data not shown). In view of the results when purified molecular probes were employed, muscle and liver tissues undoubtedly contain a significant proportion of mRNAs with either identical or homologous sequences, and these homologies result in extensive cross-hybridization. Data consistent with this conclusion have been reported (8).

In evaluating the utility of the nuclear assay presented in this and the accompanying manuscript, it is important to keep in mind several potential advantages and disadvantages of the assay. Availability of a nuclear transcription assay may be particularly useful in elucidating the molecular signals that are transmitted from the cytoplasm to the nucleus in response to altered needs for more or less mRNA. In conjunction with cloned probes containing unique isoform sequences, it may also be possible to learn the nature of the signals that induce the nucleus to switch from expression of one isoform to another. An understanding of these signals in skeletal muscle is especially important, since the isoform composition

of myosin, for example, is influenced by numerous factors such as **exercise**, disease states and degree of innervation. The present results have demonstrated that transcripts that were initiated prior to nuclear isolation are completed without loss of transcriptional fidelity or specificity. Additional critical experiments are needed to ensure that initiation of new transcripts will also occur without loss of tissue-specificity (9). Another potential use for the nuclear transcription assay is analysis of processing of primary transcripts into functional mRNAs.

Several limitations should also be considered in using *in vitro* muscle nuclear preparations. First, the absolute rates of RNA synthesis in purified nuclei seem to be several-fold lower than in living cells, and little reliable quantitative information could be obtained from comparison of specific mRNA transcription rates in nuclei isolated from, for example, control and diseased muscle tissue. Secondly, until the extent of *in vitro* processing is more precisely defined, caution should be used in interpreting data which cDNA clones (which usually only contain a portion of the 3' end of mRNA) are employed to detect the presence of initiation of new transcripts (which would occur from the 5' end of the mRNA). Either full-length cDNA clones or 5' regions subcloned from lambda bacteriophage gene libraries will be essential for the rigorous study of initiation of specific transcripts.

LITERATURE CITED

1. Dale, R.M.k., and D.C. Ward. 1975. Mercurated polynucleotides:~ New probes for hybridization and selective polymer fractionation. Biochem. 14, 2458-2469.

2. Heywood, S.M., D.S. Kennedy and A.J. Bester. 1975. Stored myosin messenger in embryonic chick muscle. FEBS Lett. 53, 69-72.

3. Ingwall, J.S., M.F. Morales and F.E. Stockdale. 1972. Creatine and the control of myosin synthesis in differentiating skeletal muscle. Proc. Natl. Acad. Sci. USA 69, 2250-2253.

4. Ingwall, J.S., C.D. Weiner, M.F. Morales, E.S. Davis and F.E. Stockdale. 1974. Specificity of creatine in the control of muscle protein synthesis. J. Cell Biol. 63, 145-151.

5. Kacian, D.L. and J.C. Meyers. 1976. Synthesis of extensive, possibly complete, DNA copies of avian myeloblastosis virus RNA in high yields and at high specific activities. Proc. Natl. Acad. Sci. USA 73, 2191-2195.

6. Kameyama, T., and J.D. Etlinger. 1979. Calcium-dependent regulation of protein synthesis and degradation in muscle. Nature 279, 344-346.

7. Myers, J.C., S. Spiegelman and D.L. Kacian. 1977. Synthesis of full-length DNA copies of avain myeloblastosis virus RNA in high yields. Proc. Natl. Acad. Sci. USA 74, 2840-2843.

8. Ordahl, C.P., and A.I. Caplan. 1978. High diversity in the poly-adenylated RNA populations of embryonic myoblasts. J. Biol. Chem. 253, 7683-7691.

9. Reeve, A.E., M.M. Smith, V. Pigiet and R.C.C. Huang. 1977. Incorpo-ration of purine nucleoside 5'-[γ-S]triphosphates as affinity probes for initiation of RNA synthesis *in vitro*. Biochem. 16, 4464-4469.

10. Riebow, J.F. and R.B. Young. 1980. Effect of leupeptin on protein turnover in normal and dystrophic chicken skeletal muscle cells in culture. Biochem. Med. 23, 316-323.

11. Schwartz, R.J., J.A. Haron, K.N. Rothblum and A. Dugaiczyk. 1980. Regulation of muscle differentiation: Cloning of sequences from α-actin messenger ribonucleic acid. Biochem. 19, 5883-5890.

12. Schwartz, R.J., and K.N. Rothblum. 1981. Gene switching in myogene-sis: Differential expression of the chicken actin multigene family. Biochem. 20, 4122-4129.

13. Thomas, P.S. 1980. Hybridization of denatured RNA and small DNA fragments transferred to nitrocellulose. Proc. Natl. Acad. Sci. USA 77, 5201-5205.

14. Young, R.B. and P.B. Blauwiekel. 1983. Embryonic chick skeletal mus-cle nuclei. I. Purification, RNA polymerase distribution and RNA synthesis. J. Ala. Acad. Sci. 54, 221-230.

15. Young, R.B., R.M. Denome and G.W. Achtymichuk. 1981. Stimulation of myosin heavy chain synthesis in steady-state muscle cultures by the ionophore, A23187, requires transcription of messenger RNA. Eur. J. Cell Biol. 26, 184-187.

16. Young, R.B., D.E. Goll and M.H. Stromer. 1975. Isolation of myosin-synthesizing polysomes from cultures of embryonic chicken myoblasts before fusion. Develop. Biol. 47, 123-135.

17. Orkin, S.H. 1978. Fidelity of globin ribonucleic acid synthesis *in vitro* by isolated nuclei: Asymmetric gene expression. Biochem. 17, 487-492.

18. Stallcup, M.R., J. Ring and K.R. Yamamoto. 1978. Synthesis of mouse mammary tumor virus ribonucleic acid in isolated nuclei from cultured mammary tumor cells. 17, 1515-1521.

THE DAUPHIN ISLAND SEA LAB: A K-PH.D. PROGRAM

George Crozier, Executive Director
Marine Environmental Sciences Consortium
Dauphin Island Sea Lab
P. O. Box 369-370
Dauphin Island, AL 36528

In 1971, the Marine Environmental Sciences Consortium (MESC) was es-
tablished by the Alabama legislature and signed into law by Governor
George C. Wallace. The concept evolved within the administrative struc-
tures of the University of South Alabama and the existing cooperative ef-
fort of the University of Alabama and the University of Alabama in Bir-
mingham. At that time it was becoming clear that education and research
within and about the marine environment was inordinately complex and
expensive, due to its interdisciplinary nature and the logistical stress
of the setting.

The obvious solution was to pool the resources available and work to-
gether. The United States Air Force partially provided the unifying prin-
ciple by declaring its radar base on Dauphin Island excess property. In
order to strengthen the attempt to acquire this property, 17 colleges and
universities joined together to form the Consortium and to develop a
statewide program of marine education, research, and service to the state.
The effort sought to avoid duplication of academic programs, faculty posi-
tions, and the enormous logistical expense of facilities and ancillary
support. An agreement was reached that led to the establishment of MESC
as a non-profit corporation/state agency complex which is unique within
the state's educational structure. Since then two additional schools have
joined, bringing the total membership to 19 (Table 1).

In May of 1972, the Air Force property was acquired and established
as the Dauphin Island Sea Lab. The director of the Marine Science Insti-
tute (University of Alabama/University of Alabama in Birmingham), C. Eve-
rett Brett, was named Interim Executive Director of MESC and Dr. Frederick
P. Whiddon, president of the University of South Alabama was elected
Chairman of the Board of Directors. Dr. Whiddon has been succeeded by Dr.
Asa Green, president of Livingston University.

The backbone of the academic programs of MESC is the Summer School.
It is during this ten-week session that the majority of the instructional
effort is made. Each member school designs an academic program appropri-
ate to its institutional goals and direction, incorporates those MESC
courses which fit its needs into its respective catalog, and enrolls
students accordingly. Certain "core" courses which have been incorporated
into specific degree programs at the institutions are offered every summer
(Table 2). The vast majority of the courses are designed at the upper di-
vision undergraduate/graduate level and are usually listed separately in
the school's catalogs. Other, more specialized, courses are offered on a

TABLE 1.   LIST OF MESC MEMBER INSTITUTIONS

Alabama State University	Talledega State College
Auburn University	Troy State University
Auburn University at Montgomery	Tuskegee Institute
Birmingham Southern College	University of Alabama
Huntingdon College	University of Alabama in
Jacksonville State University	Birmingham
Livingston University	University of Alabama in
Mobile College	Huntsville
Samford University	University of Montevallo
Spring Hill College	University of North Alabama
	University of South Alabama

TABLE 2.   SUMMER SCHOOL "CORE" COURSES

Marine Biology	Marine Ecology
Marine Invertebrate Zoology	Introduction to Oceanography
Marine Vertebrate Zoology	Marine Technical Methods I and II
Marine Botany	Coastal Climatology
Marine Geology	Commercial Marine Fisheries of Alabama

TABLE 3.   SUMMER SCHOOL ROTATING COURSES

Coastal Ornithology	Coastal Zone Management
Marsh Ecology	Recent Marine Sedimentation
Marine Paleoecology	

TABLE 4.   GRADUATE-LEVEL COURSES

Marine Animal Physiology	Oceanology of the Gulf of Mexico
Marine Zoogeography	Estuarine Science
Marine Systems Ecology	Scientific Data Management

rotating basis (Table 3) and graduate-only level courses are taught during the regular academic year (Table 4).

The summer teaching faculty are drawn largely from member schools, thus providing a modest summer employment benefit to the membership. An effort is made to bring in one or more eminent scientists as instructors so that some cross-fertilization takes place each summer. Resident faculty usually handle about 50% of the teaching load of summer school and all of the regular academic year courses. When funds are limited, as has been the case most recently, the resident faculty assume a greater percentage of the summer school program.

The target student population for the Consortium encompasses the entire state. Although it is not normally thought of as such, Alabama is a coastal state, Alabama's involvement with the marine environment far exceeds that indicated by the length of its shoreline. Of the 24 coastal states, Alabama ranks 20th in length of tidal shoreline. However, with the advent of the Tennessee-Tombigbee Waterway and attendant port expansion, the immense coastal petrochemical finds, and the consistent high market value of the seafood industry, Alabama clearly deserves a ranking higher than 20th in importance of the coastal environment to the State.

Consequently, educational programs at the "Sea Lab" have been designed to take advantage of every available communication link at all levels. Through the state school systems, K-12 classes visit the Sea Lab and experience a "hands-on" learning exercise designed specifically for their age and particular class.

During the spring, schools from all over the state and other areas, principally the mid-west and central Gulf states, spend multiple-day field trips at the Sea Lab. These extended periods usually include a structured curriculum and a variety of field trips. These excursions are designed to familiarize the student with the diversity and dynamics of the coastal environment and explore the problems of resource conflict and management. These same principles are incorporated into curricular materials distributed upon request.

A 4-week high school course is offered during the summer which incorporates all of the various elements of the coastal and marine environment. This course is given one unit of science credit by the Alabama State Department of Education. The course is taught in a relaxed, informal manner, but the material is equivalent to that taught at the college level. During this period the students are able to interact with the faculty and activities of the college program and gain some insight into post-secondary education.

The cumulative effect of the K-12 programs, organized under the title, "Discovery Hall", was recognized last year by the State. Discovery Hall was nominated as one of the state's representatives in the National Science Foundation-sponsored program, "Search for Excellence in Science Education."

First graders at Discovery Hall.

Field trip visits the beach at the Dolphin Island Sea Lab.

247

Discovery Hall Coordinator, John Dindo, demonstrates material to grade school visitors.

Marine Botany class wades ashore at Petit Bois Island.

Summer college students at the Dolphin Island Sea Lab.

Photographs provided by Dr. Judy Stout of the Dauphin Island Sea Lab.

Research activities at the Sea Lab have been driven by several forces, the most important being "regional problem solving." This euphemistically describes work in those areas where extramural funding exists. This has predictably been in environmental assessment. The geographic region studied has varied in size from a single point in the coastal waters of Mobile Bay, to the continental shelf of the Gulf of Mexico from Brownsville, Texas to south of Tampa, Florida. Sea Lab scientists have done the majority of the benthic community descriptions in that area and in Mobile Bay. The dynamics and interactions of riverine, estuarine, and oceanic waters have been studied and partially elucidated. Virtually all of the state's wetland and coastline resource areas have been mapped and categorized by MESC personnel, thus providing the data base for resource management decisions.

The majority of the MESC projects have been directed toward compatible data formatting and experimental design. In this way, projects funded by Sea Grant, Coastal Zone Management, the Corps of Engineers, and others have all been organized in a similar manner. This effort is designed to allow the incorporation of data from disparate projects to sophisticated simultaneous computer analysis to achieve a mutually beneficial result. In a situation where one project alone might not provide an adequate statistical sample for broader questions, the combination of one or more may yield significant answers. It is only through the deliberate orientation of discrete projects into a coherent package that this objective can be addressed. There are no longer the large, long-term funding sources available for single massive studies. The pursuit of these various projects has yielded a bonus in the form of experienced scientific personnel, committed to the area's needs and familiar with local problems.

Over the years, Sea Lab scientists have investigated supplemental fisheries for the the shrimp fleet, evaluated impacts of Bay development, investigated illegal dumping of reef material while monitoring the development of approved dump-sites, and responded to a variety of requests from citizens for technological assessment.

The first exploratory drilling for natural gas in Mobile Bay was expedited by the Sea Lab at the request of the Alabama Water Improvement Commission. This led to the famous oil and gas "windfall" and demonstrates the need for competency in this area. Several years later the Lab was again called on to investigate illegal discharges from these rigs. This led to the imposition of the largest fine ever received by the State. The Sea Lab has tried to maintain a position of balance and objectivity appropriate to an academic institution, but has emerged as something of an "environmental watchdog" in the minds of most people.

The principal objective of the Marine Environmental Sciences Consortium has been, and will remain, to provide a unified, coherent program of marine science education, research, and service to the state of Alabama. The need for this has never been greater in the face of pending resource demands on the coastal zone.

REVIEWS

Gosse, Philip Henry. 1859. LETTERS FROM ALABAMA, U.S., CHIEFLY RELATING TO NATURAL HISTORY. Morgan and Chase, London, England. Reprinted by Overbrook House, P.O. Box 7688, Mountain Brook, AL 35253. 324 p $12.95 (paper).

In the late spring of 1838, Philip Henry Gosse, aged 28, set off from Philadelphia to Mobile aboard a small coasting schooner. The first of his nineteen *Letters From Alabama* is an account of the voyage.

> *Pleasant society will make amends for many inconveniences, but, in my case the skipper was a churlish, vulgar, illiterate fellow, and his crew of the very same stamp as himself. The fact of my being a 'Britisher' was quite enough to warrant an incessant display of petty annoyance, which just kept short of actual insult. The conversation was of the lowest sort; and it was not the smallest infliction, that every night I was compelled to hear, as I lay in my wretched berth, the interchange of obscene narratives between the skipper and his mate, before I could close my eyes in sleep. Dirt, dirt, was the rule everywhere; dirt in the cabin, dirt in the caboose, dirt in the watercask; dirt doubly begrimed on the table-cloth, on the cups and glasses, the dishes and plates that served the food; while the boy who filled the double office of cook and waiter, was the very impersonation of dirt. The only resource was to eat with as little thought as possible, to see as little as possible, and to be upon deck as much of the time as possible; and this last habit was facilitated by the glorious weather which speedily set in after we were well off the land.*

Gosse had left England when he was 17, indenturing himself for six years as a clerk in a seal fishery in Newfoundland. At the end of this service, he attempted, with friends, to establish an idealistic cooperative farm in lower Canada. The venture failed miserably, and now almost penniless, he was setting off for the South, having heard that there were good opportunities there for educated people. Throughout these *Letters* Gosse reveals an impressive education indeed, particularly in the realm of natural history, acquired through voracious reading and a genius for perceptive observation. His formal schooling had ended when he was 15.

Aboard a steamboat journeying up the Alabama River from Mobile, he met Reuben Saffold, a distinguished pioneer settler, planter, and circuit court judge, who hired him to teach his own son and the sons of other planters in the vicinity of Pleasant Hill, in southern Dallas county. The *Letters* are an engaging account of his experiences there during the next eight months, written to an imaginary English correspondent, and published originally in serial form in *The Home Friend* magazine.

> *Suppose you just transport yourself (in imagination) to Alabama, and spend the day with me. I will be your* cicerone, *will point out to you the birds and insects, and tell you all about 'em.............*

but he tells us, too, about the manners and mores of the Alabamians. The reader is his guest at a plantation breakfast that includes grilled chicken, fried pork, and boiled rice, but also such strange dishes as homminy, "woffles", and Indian bread *(as so little wheat is grown here as to make wheat-flour be considered almost a luxury)*, the nature and preparation of which he describes in detail. He writes of his schoolhouse, *a funny little place, built wholly of round, unhewn logs, notched at the ends to receive each other, and the interstices filled with clay . . . ,* and his twelve pupils, *mostly, as rude as the house, real young hunters, who handle long rifle with more ease and dexterity than the goose-quill, and who are incomparably more at home in twisting a rabbit or treeing a 'possum, than in conjugating a verb . . .* But as his title indicates, the *Letters* relate chiefly to natural history. Insects are Gosse's particular facination, but there are extensive descriptions of birds and other wildlife, as well as plants, both wild and domestic.

In their annotation of the present edition, Drs. Daniel Jones and Ken Marion of the Department of Biology, University of Alabama in Birmingham, provide modern binomials and modern vernacular names of the species described, and have thereby greatly increased the usefulness and appeal of the book to most readers with an interest in plant and animal wildlife.

Gosse not only creates for his reader a picture of natural and societal life in the black belt of 1838, but throughout the book in his impressions and reactions to both its beauties and its horrors he also reveals, like other writers of other fine travel books, an affecting portrait of himself, a somewhat fusty, stiff-necked, yet adventurous young man of most uncommonly perceptive intellect, on his own in a strange land.

> *What is to become of the slaves, if they be emancipated? To throw two millions of persons, uneducated and uncivilized, smarting under a sense of accumulated wrongs, at once loose upon society, would be more than dangerous, it would be certain destruction.*
> *Yet the institution is doomed. Its end approaches surely, perhaps swiftly. Its fall cannot but be ardently desired by every right-thinking mind, for it is one begun, pursued, and perpetuated in iniquity and cruelty; but when it comes, it can hardly be other than a terible convulsion. I never felt this so strongly, as since I have had personal and close observation of the elements of the strife, the parties at issue. In spite of the beauty and grandeur of the country, the lucrative remuneration which a person of education receives for his talents and time, and the rich and almost virgin field for the pursuit of natural history (no small temptation to me),-- I feel slavery alone to be so enormous an evil, that I could not live here: I am already hastening to be gone.*

Norton L. Marshall
*Department of Botany, Plant
  Pathology, and Microbiology
101 Cary Hall
Auburn University
Auburn University, AL 36849*

REVIEWS

Jones, Warren, Bobbie Jones, Kevin Bower, and Mel Ray. 1983. COMPUTER LITERACY. Reston Publishing Co.

Are you contemplating buying a personal home computer? Are you nervous that the "computer age" is no longer coming, but is here now, "today"? Perhaps you have already purchased one of these computers – say an Apple – and are now trying to decide what is the next logical step.

A book that you might find helpful if you fall into either of these groups is a book intitled *Computer Literacy*. As the name implies, it is a book for the beginner designed to aide in the development of a "conversational" knowledge base. Yet, it is more than this. It is a book written by educators (who have obviously had a great deal of experience in educating computer illiterates) to expose the new microcomputer owner to general principles as well as application of computer technology to science, entertainment, and educational objectives. It should be noted that the book uses the Apple computer as the model system throughout.

The book is divided into five parts. These include 1) getting acquainted with your computer, 2) problem solving, 3) historical perspectives, 4) programming and communications, and 5) computer applications. The authors first take the reader through a guided tour of the Apple's internal components. From here they move to the explanations of the actual operation of the Apple (chapter 2). This includes a quick overview of the types of computer language and some exploration of the text and graphic capabilities of the Apple. Chapter 3 provides a discussion of how the computer can be used in problem solving. As was pointed out above, the examples, programs and discussions of the book are centered around the Apple computer system. The succeeding three chapters however are applicable to any computer system. Chapter 4 gives an overview of topics in programming such as organization of programs into modules using subroutines.

The slant of the book changes with the remaining three chapters. The close association of the first five chapters is broken by the treatment of special topics. Chapter 8 reviews the characteristics of various types of mainframe and personal computer communications (such items as networking and electronic mail are discussed). Finally, chapter 9 discusses issues that concern society, such as computer crime, privacy encroachment, robotics, and the office of the future.

As you can tell by the topics of each of the sections, the book does indeed address the topic of computer literacy. It is written for the beginner who really does not know where to begin. For the reader who desires more in depth coverage of specialized topics, an adequate bibliography is presented at the end of each chapter.

Some of the positive aspects I found appealing about the book were the behavioral objectives preceding each chapter, followed by review questions and a review of new words at the end of each chapter. The only

negative comment centers around the use of only the Apple as the model computer system. If you happened to buy an IBM-PC or a Texas Instruments computer, you may find the description of the inner workings of the Apple uninteresting. In addition, Applesoft, which is the dialect of Basic utilized by the Apple, is somewhat different than the Basic found on other microcomputers, and may be somewhat of a nuisance. If you own an Apple and you do not know how to begin, then this book is a good place to start.

Kennon Francis, Associate Editor
School of Community and Allied Health/
Division of Physical Therapy
The University of Alabama in Birmingham
Birmingham, AL 35294

INDEX

Index

Index

1983 Membership Roll by Section

SECTION I
BIOLOGICAL SCIENCES
Abee, Christian R.
Adams, Caroline
Albright, C. Wesley
Alexander, Herman D.
Ball, Mary U.
Barker, Steve
Beasley, Philip G.
Benford, Helen H.
Beyers, Robert J.
Bennett, L. L.
Blackmore, Mark S.
Boozer, Reuben B.
Bradley, James T.
Braid, Malcolm
Brannon, Mary Jane
Brown, Burke
Brown, George B.
Brown, Jack S.
Buckner, Richard L.
Buerger, Theodore
Campbell, P. Samuel
Carey, Steven D.
Carter, Gregory A.
Causey, Ann S.
Chambers, William H.
Cheshire, L. Bryan
Clelland, Jo
Clements, Ben A.
Cline, George B.
Cochis, Thomas
Cooper, John E.
Costes, Danice H.
Craven, Rebecca C.
Creswell, Tom C.
Cross, Earle A.
Curl, Elroy A.
Dalrymple, Mary
Darden, William H., Jr.
Davis, Mark S.
Davis, Donald R.
Denton, Thomas E.
Diener, Urban L.
Dietz, Robert
Dimuzio, Michael T.
Dixon, Carl
Dubovsky, Jiri
Dusi, Julian L.
Dusi, Rosemary D.

Edge, Mark T.
Einspahr, Howard M.
Fincher, John A.
Finley, Sara C.
Folkerts, George W.
Frandsen, John C.
Furman, Gary C.
Gates, William R.
Gauthier, Joseph J.
Gibbons, Ashton
Gintis, Bonnie Ownley
Glaze, Robert P.
Golab, Dorothy K.
Goode, Naaman D.
Grastka, William
Greene, John
Gudauskas, Robert T.
Halijak, Charles A.
Harper, James D.
Harvey, Stephen C.
Haynes, Thomas B.
Hemphill, A. F.
Henry, J. Leonard
Higgins, Karol S.
Hodges, Laurie
Holland, Richard D.
Holliman, Dan C.
Hsu, Joseph
Hunter, Fiona
Huttlinger, Frank D.
Ivey, William D.
Jensen, Ove W.
Jones, Patricia H.
Karr, Guy W., Jr.
Kase, Carlos S.
Kelley, Teresa A.
Kendrick, Aaron B.
Keys, Charles
Kidd, William H.
King, Tommy
Klopfenstein, Miriam
Koopman, William J.
Kouskolekas, Costas A.
Krumdieck, Carlos L.
Landers, Kenneth E.
Lawrence, Faye B.
Lawton, Robert O.
Lelong, Michel G.
Lindsay, David S.
Lisano, Michael E.

Lishak, Robert S.
Lockwood, Susan L.
Mack, Timothy P.
Macmillian, William H.
Manning, James M
Marion, Ken Roy
Mason, Linda
Mason, William H.
McCord, Joe
McCullough, Herbert A.
McGinty, Douglas T.
McKee, Dorothy W.
McKibbin, John M.
McKinney, Rose B.
McLaughlin, Ellen W.
Miller, Margaret
Mirarchi, Ralph E.
Mitchell, Beverly A.
Modlin, Richard F.
Moore, Bobby G.
Modlin, Pamela S.
Moore, Jack H.
Morgan, Paul H.
Mount, Robert H.
Mullen, Gary R.
Muller, Lisa
Myers, Lawrence J.
Nancarrow, Virginia
Nash, Renee A.
Nelson, David H.
Nelson, Fannie
Nicholson, Nanette
Niedermeier, William
Northrup, Robert S.
O'Kelley, Joseph C.
Okia, Nathan O.
Ottis, Kenneth
Paxton, Mary Jean W.
Peterson, Curt M.
Petranka, James W.
Pritchett, John F.
Quindlen, Eugene A.
Ramsey, John S.
Ravis, William R.
Reed, Russell B.
Richardson, Velma B.
Rickert, Edward J.
Robinson, George H.
Rosa, Edward Molinar
Rostand, Katherine S.

Sack, John S.
Sanford, L. G.
Sartin, James L.
Sawyer, Mary F.
Sheldon, Mary Amy
Sherill, Dorothy E.
Shew, H. Wayne
Singh, Shiva P.
Smith, C. E.
Stevens, Clauzell
Strada, Samuel J.
Taylor, Julie R.
Thomas, Julian E.
Till, M. L.
Townsend, Janet K.
Truelove, Bryan
Tucker, Charles E.
Tucker, William H.
Turner, C. J.
Ultsch, Gordon R.
Walker, J. H.
Washburn, Michelle
Watson, Jack E.
Whatley, Booker T.
Whitlock, Suzanne
Wilkes, J. C.
Wilkoff, Lee J.
Williams, Ann H.
Williams, Carol S.
Williams, John W.
Williams, Michael L.
Wills, John W.
Wilson, H. J.
Wilson, Mack A.
Wit, Lawrence C.
Yearwood, Kirtley
Young, Ronald B.

SECTION II
CHEMISTRY
Allen, Roger W.
Arendale, William F.
Baker, David
Barrett, William J.
Beck, Mary Jim
Brown, Mary A. H.
Cappas, Constantine
Chastain, Ben B.
Cooper, E. A.
Corona, Barry
Cottingham, Harry H.

Cox, A. Barry
Dillon, H. Kenneth
Dinius, Robert H.
Finkel, Joe M.
Finley, Wayne H.
Ford, Jonathon
Gaudin, David
Gaunder, Robert
Haggard, James H.
Hazlegrove, Leven S.
Ho, Mat H.
Iozia, Donna Lee
Isbell, Raymond R.
Johnson, Robert B.
Kispert, Lowell
Krannich, Larry K.
Lambert, James L.
Laseter, W. Ray
Livant, Peter
Ludwick, Adriane
Mahaffey, C. A. L.
Menikheim, Virginia C.
Moeller, Michael B.
Moore, McDonald, Sr.
Mountcastle, William
Muller, John H.
Ragasa. Joseph C
Rawlings, Jill
Settine, Robert L.
St. Pierre, Thomas
Thomas, Joseph C.
Thompson, W. D.
Toffel, George M.
Toren, E. Clifford, Jr.
Vallarino, Lidia M.
Vigee, Gerald S.
Wakefield, Z. T.
Ward, E. H.
Webb, Thomas R.
Wheeler, G. P.
Whitt, Carlton D.
Youngsblood, Bettye

SECTION III
GEOLOGY
Allison, Calvin E.
Barton, Jackson M.
Bearce, Denny
Brosheer, Clinton J.
Bundschu, A. Lindsay
Carrington, Thomas J.

Chase, Duane O.
Connell, James F. L.
Cranford, Norman B.
Daniel, T. W.
Dejarnette, David L.
Gastaldo, Robert A.
Gillaspie, Leon W.
Gross, Whitman, II
Henson, Sharon
Isphording, Wayne C.
King, David T., Jr.
Lamb, George M.
Lamoreaux, P. E.
McMillan, Richard C.
Neilson, Michael J.
Powell, William
Sides, Garry L.
Springston, George E.
Stock, Carl W.
Thurn, Richard L.
Tompa, Brad S.
Usdansky, Steven I.
Wade, George D.
Wells, Faye

SECTION IV
FORESTRY, GEOGRAPHY,
CONSERVATION, AND
PLANNING
Barnes, Timothy E.
Boyer, William
DeVall, Wilbur B.
Gibbs, George S.
Harper, Russell W.
Himmler, Frank N.
Holland, Andrea P.
Icenogle, David W.
Johnson, Howard P.
Kallsen, Thomas J.
Lamb, Steven F.
McInnish, Mary K.
Meyer, Darrell
Osterlund, Merilyn J.
Patterson, Tommy
Sax, Steven R.
Smith, Douglas A.
Strong, William Reese
Tamarin, Pam
Tang, R. C.
Weaver, David C.
Woodley, Donald R.

SECTION V
PHYSICS AND MATHEMATICS
Alexander, Chester
Alford, William L.
Allison, D. Lee
Ball, Raiford M.
Bateman, B. J.
Bauman, Robert P.
Beiersdorfer, Peter
Byrd, Gene G.
Castillo, Oreste
Chao, Shoa-Hua
Chowdhury, Rishi Raj
Christiensen, Charles
Colvett, Robert Dee
Curott, David R.
Davis, Jack H.
Dessler, A. J.
Dodhy, Adila
Easterday, Kenneth
Essenwanger, Oskar K.
Forte, Aldo
Furman, W. L.
Glotfelty, Henry W.
Goodall, Marcus C.
Harrell, James W., Jr.
Hartman, Richard L.
Hawk, James F.
Hudson, Glenn
Jones, Stanley T.
Kane, John
Kassim, Abd
Kaylor, Hoyt M.
Kribel, Robert E.
Lake, James E.
Lundquist, Charles A.
Martin, James C.
Mcauley, Van A.
Miyagawa, Ichiro
Morton, Perry W., Jr.
Omasta, Eugene
Piccirillo, John
Polan, Marvin
Rash, Ed
Reid, William J.
Reisig, Gerhard
Rives, Carol J.
Robinson, Edward L.
Shealy, David L.
Shipman, Jerry R.
Smoot, Henrene

Stewart, Dorothy A.
Sulentic, J. W.
Vaughan, William W.
Vinson, R. G.
Visscher, Pieter B.
Werkheiser, A. H.
Wheeler, R. E.
White, T. J.
Wilkinson, E. L.
Williams, John R.

SECTION VI
INDUSTRY AND ECONOMICS
Adrian, John L.
Baker, Walter
Bickley, John S.
Borden, Amanda W.
Chastain, E. D.
Chen, Jim
Crawford, Gerald
Culverhouse, Renee
Damtew, Desta
Dilbeck, Sherry
Free, Veronica
Friese, Charles, L
Gatlin, Kerry P.
Geer, William D.
Gentle, Edgar C., Jr.
Graves, Katherine M.
Gregorowicz, Philip
Griffin, Marsha D.
Harrison, Golson
Haynes, James F.
Head, Holman
Helms, Billy P.
Henderson, H. A.
Jackson, Leslie T.
Johnson, Raymond
Lacy, Wayne
Lake, Robert
Lortie, John W.
Marcus, Norman
McInnis, Martha Ann
Meade, Dale
Moberly, H. Dean
Prewitt, Lena B.
Rodgers, M. R.
Russell, Keith A.
Schroeder, Fdward A., IV
Seldon, James R.
Seldon, Zena A.

Smith, Leon L.
Spencer, C. A., Jr.
Stallings, James L.
Stewart, G. T.
Stewart, William S.
Sullivan, George M.
Viohl, Frederick A.
Walker, William H.
Weaver, Janice E.
Wilbourn, Macon
Willhardt, John A.

SECTION VII
SCIENCE EDUCATION
Ball, Patsy
Bigham, Betty
Bilbo, Thomas Earl
Bradford, Ibbie King
Bundrick, Linda L.
Catlin, Mentor
Clark, Neil Penton
Coffman, Lindsey F.
Corina, Eugenia K.
Eubanks, Eleanor E.
Fish, Frederick P.
Gilder, Joy D.
Gonce, Mary N.
Landers, John I.
Ludwick, Larry M.
McDade, Claudia
Medders, George C., Sr.
Meek, E. F. Martin
Murphy, Barbara
Nall, Jane
O'Brien, James M.
Ormand, Janet
Reynolds, Barbara S.
Rice, Dale R.
Riggsby, Dutchie S.
Riggsby, Ernest D.
Rowsey, Robert E.
Schell, Roy H.
Shell, William B.
Short, William A.
Sie, Swanpo
Simon, Marllin L.
Smith, Joseph W.
Turner, E. J.
Walton, Edward C.
Warren, Bertie Mae
Welker, J. D.

Whitson, Dan
Wolfinger, Donna M.

SECTION VIII
SOCIAL SCIENCES
Allen, Lawrence
Beckwith, Guy
Buckalew, L. W.
Campbell, Caine
Cantrell, Clyde H.
Cobb, A. Lee
Crampton, Roger B.
Douty, Helen I.
Dunkelberger, John E.
Elixon, Joseph M., Jr.
Giles, Barbara M.
Hall, Hines H., III
Hayhurst, Don E.
Inman, Henry F.
Johnson, James A., Jr.
Lacy, Roger
Marks, Marsha Kass
Martin, David L.
Metzger, Mary C.
Myers, John B.
Palileo, Gloria J.
Sink, David W.
Slattery, Patrick D.
Smith, Frederick P.
Steele, H. E.
Summersell, C. G.
Thompson, James J.
Uhlig, George E.
Vocino, Thomas
Webber, Avery
Weber, B. C.
Yeager, J. H.

SECTION IX
HEALTH SCIENCES
Acton, Ronald T.
Addison, Mark K.
Al-lami, Fadhil A.
Allen, Raleigh H., Jr.
Awtrey, Janet S.
Barker, Samuel B.
Baugh, Charles
Beaton, John M.
Beck, Lee R.
Bendit, Joseph N., Jr.
Benshoof, Sharon A.

Bergman, Joan S.
Bhatnagar, Yogendra M.
Blackwood, Katrina A.
Boots, Larry R.
Boshell, Jerry L.
Braverman, Eleanor B.
Breslin, Frances A.
Brown, Jerry W.
Buckner, Ellen
Carmichael, Emmett
Carmichael, John L.
Carroll, Andrew J., III
Chambers, David E.
Clotfelter, Ann
Conary, Jon T.
Cornwell, P. E.
Covey, Patsy C.
Culpepper, Michael I.
Cusic, Anne
Dagg, Charles P.
Davis, Richard
Davis, William B.
DeRuiter, Jack
Devivo, Michael J.
Dozier, Frank L.
Dustan, Harriet P.
Elgavish, Ada
Ellison, Kathy Jo
Elmore, Carol R.
Elsas, Frederick J.
Emerson, Geraldine M.
Faris, Arthur W.
Faught, R. Edward, Jr.
Faulk, Lynne G.
Faulkner, Robert D.
Ford, Doris E. Dinkins
Francis, Kennon T.
French, James H.
Furner, Raymond L.
Gardner, William A., Jr.
Gaubatz, Jim W.
Gennaro, Susan
Ghai, Rajendra D.
Gilbert, Fred
Gueldner, Sarah H.
Hanson, Edward S.
Hefner, Lloyd L.
Heggie, Glen D.
Hemp-Hazeltine, Jeff
Henry, Beverly
Herbert, Donald

Hirschowitz, Basil I.
Hoffman, Henry H.
Holley, Howard L.
Huang, Chi-Tsou
Hughes, Edwin R.
Hughes, Glenn H.
Jackson, Cynthia Ann
Johnson, Evelyn Pointer
Johnson, E. Van
Jones, Harold P.
Jones, L. Ralph
Keith, Robert E.
Keller, Nancy
Kelley, Jean
Kemppainen, Robert J.
Kirklin, John W.
Kittrell, Elizabeth J.
Kleinstein, Robert
Kuhlemeier, K. V.
Lamon, Eddie W.
Lancaster, Jeanette
Lane, Roger S.
Leeper, James D.
Long-Hall, Carolyn K.
Mainland, Rosemary C.
McCallum, Charles
McClinton, Virginia
McCombs, Jerome
McKnight, Jerry T.
McLain, Cecil Ray, Jr.
Meezan, Elias
Morgan, Alice H.
Moss, Neil
Murray, Elizabeth W.
Nair, M. G.
Neely, Brett H.
Nixon, Aileen L.
Oldham, Walter J.
Oliver, Euel M., Jr.
Parsons, Daniel L.
Pass, Robert E.
Paul, Thomas O.
Perry, Nelson
Phillips, J. B., III
Phillipson, Beverley E.
Piazza, Gary A.
Pierce, John T.
Pieroni, Robert E.
Pillion, Dennis J.
Pirkle, James A.
Pittman, James A., Jr.

269

Rector, James
Reid, Barbara J.
Roberts, Janice W.
Rodning, Charles B.
Rodzen, Kenneth J.
Roush, Donald
Schnaper, Harold W.
Scungio, Joanne B.
Sheffield, L. T.
Shoemaker, R. L.
Singh, Baldev B.
Skalka, Harold W.
Skipwith, Delois H.
Sloan, Rebecca H.
Slocum, Harvey C., Jr.
Sorrell, Walker B.
Stevenson, Elizabeth C.
Sunni, Senussi
Swansburg, Russell C.
Tan, Boen Hie
Taylor, Kenneth B.
Taylor, Marianne R.
Thames, Terri
Thompson, Jerry N.
Todorov, Alexandre
Trawinski, Irene
Vacik, James P.
Vermeire, Patricia E.
Volker, Joseph
Ward, J. W.
Wilborn, W. H.
Wilkerson, Elizabeth A.
Williams, Gail S.
Wilson, Graeme
Winternitz, William W.
Yielding, Lerena
Young, Wesley O.
Yu, Susan B.

SECTION X
ENGINEERING AND
COMPUTER SCIENCE
Barfield, B. F.
Barrett, John H.
Boland, Joseph S.
Brullman, August W.
Cain, John L.
Chen, Imao
Craig, Thomas F.
Crawford, Martin
Dean, Susan T.
Dillon, Ira G.

Foust, D. T.
Glass, Wayne R.
Goodman, Charles H.
Hayes, Russell M., Jr.
Hearn, William H.
Hermann, Rudolf
Hool, James N.
Jacobs, Donald B.
Jacobs, Paul L.
Kelly, William C.
Kurzius, Shelby C.
Lynn, J. Daniel
Maghsoodloo, Saeed
McWhorter, Larry
Moulton, V. Gordon
Otto, Gunther
Parker, Donald L.
Pittman, William C., Jr.
Planz, Edward J.
Rindt, Donald W.
Rodriquez, Harold V.
Roggio, Robert F.
Shaffer, Harry B.
Stark, John
Stefanescu, Doru M.
Story, Albert H.
Thurstone, R. L.
Vanstrum, Mark D.
Walters, J. V.
Wisniewski, Raymond B.

SECTION XI
ANTHROPOLOGY
Alexander, Lawrence S.
Allen, Jeanie
Cottier, John W.
De Luca, Michael A.
Gay, Robert W., Mrs.
Gilliland, M. Janice
Gyllenhall-Davis, C.
Hall, John
Hansen, Asael
Hatcher, Eddie
Henson, B. Bart
Hesse, Brian C.
Hill-Clark, Cassandra
Hollingsworth, Caryn Y.
Huscher, Harold A.
Knight, Vernon J., Jr.
Nance, C. Roger
Nesbit, Paul

Powell, Mary Lucas
Rowe, Bobby
Searcy, Margaret
Sheldon, Craig T.
Sheldon, Elizabeth S.
Skrivan, Robert J.
Solis, Carlos
Stanley, T. Loren
Tanks, Sylvia
Turner, Kathleen D.
Turner, Kenneth D.
Wapnish, Paula
Wheatley, Bruce

Notes

Publication and Subscription Policies

Submission of Manuscripts. Submit all manuscripts and pertinent correspondence to the EDITOR. Each manuscript will receive two simultaneous reviews. For style details, follow Instruction to Authors (see inside back cover).

Reprints: Requests for reprints must be addressed to authors.

Subscriptions and Journal Exchanges: Address all correspondence to the CHAIRMAN OF THE EDITORIAL BOARD.

BENEFACTORS OF THE JOURNAL OF THE ALABAMA ACADEMY OF SCIENCE

The following have provided financial suppport
to partially defray publication costs of the Journal.

CONTENTS

COMPUTERS AND STATISTICS

David C. Naftel
Department of Surgery
Department of Biostatistics and Biomathematics
University of Alabama in Birmingham
University Station
Birmingham, AL 35294

ABSTRACT

In the early years of the electronic computer, statisticians used it mainly as a high speed calculator that could quickly perform some of the tedious calculations necessary for data analysis. However, during the past 30 years the computer has evolved into a potent force in shaping the field of statistics at both the applied and theoretical level. Today the computer is used in the design of experiments, data collection, data management, data analysis, graphical displays, model building and simulation. Computers now affect the development of statistical methodology, the training of statisticians, the storage and management of data, the presentation of data, and the relationship between statistician and researcher. This paper examines the relation between computers and statistics as it exists today.

I. INTRODUCTION

The computer is an important tool for most statisticians. Since its creation the electronic computer has fulfilled the statistician's desire and need for a high speed, accurate calculator. The original interaction was between a statistician who was weary of calculating sums of squares and a tool that could quickly perform this tedious task. It is important to note that the computer made no decisions regarding which calculations to make, and the brand of the computer was essentially irrelevant to the results. Both of these facts are still true today.

Things have changed tremendously since these early interactions during the 1950's. The number and availability of computers and statistical software packages have increased dramatically. The computer is still a tool, but it is a tool with many uses in the field of statistics. It is used in every step of analysis of research data, and is becoming an important part of many aspects of theoretical statistics.[12,13]

Section II of this paper examines the infiltration of computers into the statistical profession. In Section III the role of computers in applied statistics is examined, while Section IV looks at the effect and use of computers in theoretical statistics. The role of the statistician in the research process has changed and has potential for more change because of computers. This change is discussed in Section V. Section VI looks at the negative side of the computer age in regards to statistics, while Section VII focuses on conclusions and the future.

II. USE OF COMPUTERS BY STATISTICIANS

Computers have permeated every phase of statistics. Textbooks, journals and research reports commonly make references to computers and the associated software.

History

Statistics quite often involves the sorting and tabulating of great amounts of data. The primary example for this task is the U.S. Census Bureau and its almost innumerable summaries and descriptive statistics. The 1890 census was analyzed using a mechanical forerunner of the electronic computer[7]. The machine was conceived by John Shaw Billings and implemented by Herman Hollerith. It used punch cards to store information, and enabled the superintendent of the 1890 census to announce the total population just one month after all of the returns had arrived in Washington. This machine provided the basis for the future International Business Machine Corporation (IBM).

The development of the electronic computer during the 1940's and early 1950's was quickly followed by its use in statistical calculations. Originally each user wrote his own program for a specific statistical calculation. Soon statistical packages were developed which combined several programs into one accessible system for analysis of data. These packages also included the capability for data management.

Statistical Packages

The collection of instructions, known as software, that directs the computer is as important as the computer itself. Statistical software designed to perform the calculations for a variety of statistical methods exists in the form of statistical packages. The statistical package began as a small collection of computer programs that could compute basic descriptive and inferential statistics. As a package grew it included more programs, and usually included the ability to manage data and to generate limited numerical reports.

Some of the more popular packages include the Statistical Analysis System (SAS)[17], the Statistical Package for the Social Sciences (SPSS)[3] and the Biomedical Computer Program (BMDP)[4]. Each of these packages includes programs that cover a wide variety of statistical methodology. These packages are accessible to anyone who has data, needs an analysis, and has access to a computer. The user does not need a programming background to learn the basics of the packages. However, one must always be aware that it is the user who decides which statistical analysis is appropriate for his data. The statistical package (and therefore the computer) makes no decision regarding the appropriateness of applying a particular statistical method to a particular data set.

Most large computer installations support several statistical packages. At the University of Alabama in Birmingham, the Central Computer

Center supports SAS, SPSS, BMDP and several smaller packages. Figure 1 illustrates the frequency of usage of specific programs by research and academic users during September 1983 on the IBM 4341 at this center. Note that SAS was the most frequently used package during that month.

PROGRAM USAGE

TOP 25 PLUS MISCELLANEOUS
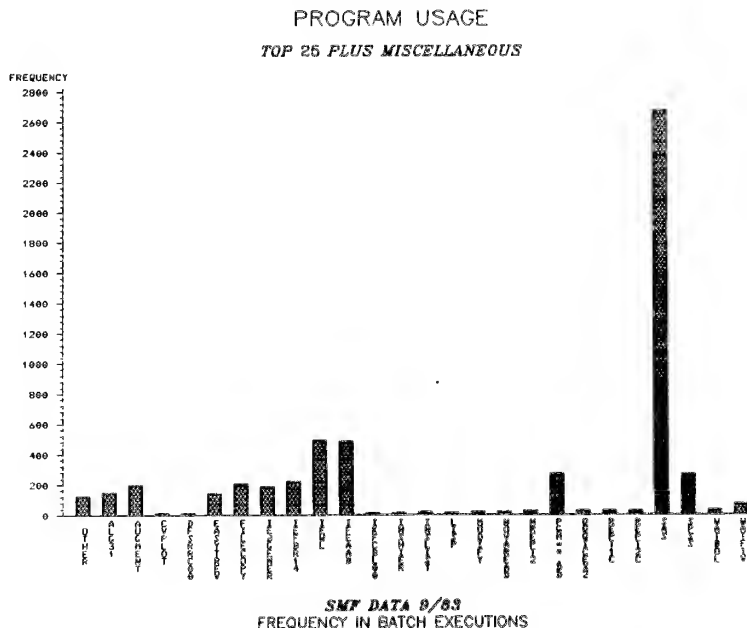

SMF DATA 9/83
FREQUENCY IN BATCH EXECUTIONS

Figure 1. Frequency of program usage by academic and research users on an IBM 4341 at the University of Alabama Central Computing Center for September, 1983. This figure was created using SAS GRAPH on an IBM plotter.

SAS was created by Barr and Goodnight in 1966 at North Carolina State University. By 1972 it contained 30 procedures described in two instruction manuals. The 1982 version of SAS contains approximately 87 procedures described in eight manuals. SAS contains procedures for analysis of variance, multiple regression, nonlinear regression, nonparametric statistics, time series, survival analysis, factor analysis, matrix manipulation and many others. It can be used as a programming language and is a flexible data management tool. Simulation studies are possible. SAS Graph[16] is a new feature of SAS that can produce many kinds of plots, including three dimensional plots. Figures 1 and 2 in this article were produced by SAS Graph.

Some of the larger packages are making a move toward implementation on mini-computers. SAS now has a version that will run on VAX, ECLIPSE,

3

and PRIME minicomputers, and BMDP has a version called STATCAT that runs on a digital minicomputer.

Recently a large number of statistical programs have become available for microcomputers. Neffendorf[15] (1983) lists 29 sources for statistical programs for microcomputers.

New Slant for Textbooks

As computers and software have become more generally available, many statistical textbooks have reflected this by referencing statistical packages or by publishing their own programs. The second edition of *Biometry* by Sokal and Rohlf[20] (1981) makes available a collection of 22 programs that match the methodology presented in the book. These programs run on microcomputers. This represents a major change from the first edition in 1969[19] which contained no references to computers in the text.

Many of the more recent books on linear and nonlinear estimation and statistical theory contain discussions or references to computer programs that are applicable to their topics[5,1,21,2]. A number of books on survival analysis either refer to statistical packages[9,14,6] or give programs in the text.[14,11]

This recognition of computers by statistical textbooks did not begin until the 1970's. The authors of these textbooks are demonstrating an appreciation of the fact that an applied statistician must be familiar with computers and the available statistical software.

Professional Societies

The American Statistical Association (ASA) recognizes the impact of computers on statistics by regularly including in the *American Statistician* a section on new developments in statistical computing. At the 1983 annual ASA meeting there were eighteen sessions that directly involved some aspect of computers or statistical software. Session titles included "statistical software," "use of computers in coding survey responses," "theoretical issues of computing," "software for microcomputers" and "exposition of statistical graphics technology."

There are also a number of journals devoted to statistical computing, e.g., "Journal of Statistical Computation and Simulation" and "Communication in Statistics B, Simulation and Computation."

III. THE USE OF STATISTICS IN SCIENTIFIC RESEARCH

Computers and associated statistical software have had their greatest impact on scientific research, especially the analysis of data. The computations involved for statistical tests are tedious and prone to error when done by hand or even with a calculator. The computer excels at this

type of arithmetic.   The computer has also been used in other phases of
research from the design of experiments to the final report.

Design of Experiments

Many experiments require careful preliminary analysis to provide an
optimal design that will efficiently answer the proper questions.   This
includes sample size calculations, power of tests, and even simulation of
possible results.   The computer is often used for the calculations in-
volved for these tasks.   A key part of experimental studies is the ran-
domization of the experimental units.   Many statistical packages include
the generation of random numbers.   SAS has a procedure for randomization
schedules for multi-factor studies.

Data

The foundation of any statistical analysis is the data.   The computer
has become a useful tool in data acquisition, data editing, and data man-
aging stages of the analysis.

In properly planned research much attention is given to the collec-
tion and organizing of data.   If a computer is to be involved then the
data entry must be considered.   This usually means a carefully designed
collection form.   Constructing such a form necessitates an initial intel-
ligent look at the variables to be gathered and the range of possible
values.   This additional thought at the beginning of the research often
identifies correctable problems, redundant variables, and impractical
variables.   This logical front-end thinking is a direct consequence of the
involvement of the computer in the research process.

The computer is also being used in direct data acquisition where the
computer is interfaced with a measuring device.   This online data entry
eliminates clerical errors and keypunching errors, but substitutes its own
set of possible errors.

The creation and maintaining of registries has been the result of the
computer's ability to store and retrieve data extremely efficiently.   A
registry is a data set stored on a computer or a computer system that con-
tains information about a specific group of subjects.   For example there
are national tumor, diabetes, and heart registries.   Each of these reg-
istries contain medically pertinent data about a group of patients who
have a common disease.   These registries are often the result of combining
information from many medical centers.   These registries are then accessi-
ble by many different analysts with different questions.

Computers are used as tools in the process of editing and checking
data.   Variables can be screened for unusual or impossible values, e.g.,
height coded to be greater than seven feet.   The computer can also search
for and identify records with improbable combinations of variables, e.g.,
it can identify all records of people who are less than ten years old and

5

have a college education. Notice that the computer can only identify such problems. The user of the computer must precisely instruct the computer to make the corrections. There are a number of programs available for on-line editing of computer data sets (SPF,[10] FSP,[18]). These programs allow immediate changes to a data set stored on disk.

This type of computer editing of data sets is quite useful in clean-ing a data set, but it cannot uncover all incorrect entries. A man five feet and ten inches tall who was coded as five feet and eight inches tall will never be identified by computer editing. The only way to correct all errors in a data set is by line by line checking of computer data against the original data source. This is a tedious and often overlooked task.

The analysis of data often involves intense data handling before the actual computations can begin. The computer is well suited to this man-agement of data. The tasks include subsetting of the data, updating a data set, merging of two data sets, and sorting the data according to the values of a particular variable. Often a variable must be transformed before it can be used. For example, all heights that were coded as centi-meters can be transformed to inches. Sometimes a new variable must be calculated for other variables. For example, if height and weight are recorded then a new variable, body surface area, can be calculated as a function of height and weight. Once again the computer can be instructed to quickly and accurately perform these data tasks.

Statistical Analysis

The computational aspect of analysis of data remains as the area of statistics that has benefited the most from computers. It is here that the statistician has been able to dramatically increase the scope and ef-fectiveness of his efforts.

Basic statistical methodology such as descriptive statistics, analy-sis of variance, regression, and correlation require many calculations which increase as the numbers of observations increase. The calculations themselves are the result of numerous simple equations, yet they become quickly burdensome and prone to error as the sample size increases. Com-puters remove these calculations from the statistician. The result is a vast savings in time and an increase in reliability.

Many statistical techniques were developed before computers were gen-erally available, but were impractical without a high speed calculator. An example is stepwise regression which covers several techniques for se-lecting a subset of explanatory variables that are significantly associat-ed with a response variable. The calculations are formidable, including the inversion of many matrices. The computer along with statistical soft-ware now makes stepwise regression as accessible as a t-test. Other sta-tistical methods which were not practical for large data sets until the advent of the computer include time series analysis, factor analysis, ca-nonical correlation, logistic regression, Cox regression, parametric sur-vival analysis, and multivariate analysis.

There are a number of statistical estimation methods that require it-
erative solving of equations to produce estimates. That is, an answer
does not exist in a closed form, but must be calculated by numerous re-
finements of an initial guess. This iterative solving is virtually im-
possible without a computer. Iterative solutions are involved in many
non-linear regression problems and in the estimation of parameters for
many distributions (e.g., the Weibull and gamma distributions). Figure 2
graphically displays the results from iterative estimation of the para-
meters from two distributions fitted to the product-limit estimates of
symtom-free survival of patients with congenital pulmonary valve incompe-
tence.

PULMONARY VALVE INCOMPETENCE
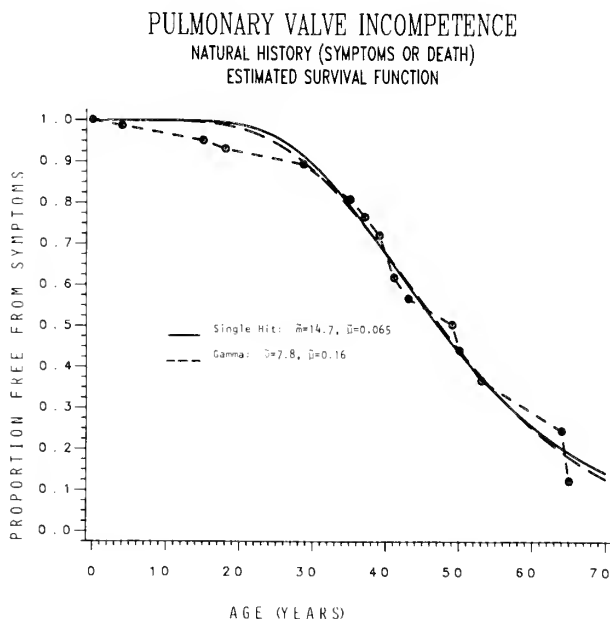### NATURAL HISTORY (SYMPTOMS OR DEATH)
ESTIMATED SURVIVAL FUNCTION

Figure 2. Natural History of Pulmonary Valve Incompe-
tence based on cases in the literature and
two estimated survival functions. This
figure was created using SAS Graph on a
Zeta 1453 plotter, and the estimation of
the lines was performed using PROC NLIN
from SAS.

The relative ease of applying statistical methods to data when using
a computer has encouraged many statisticians to go beyond the planned
analysis of the data. The statistician can quickly examine descriptive
statistics, histograms, scattergrams, and correlations of all variables to
identify unexpected trends and relations. At the very least such addi-
tional looks at the data can be the impetus for subsequent studies.

All inferential statistics involve assumptions about the data. For example, the t-test requires the assumption of the variable having a normal distribution. Without computers the statistician often merely states such assumptions and proceeds with the test. With computers such assumptions can be examined with plots and tests for normality. Thus computers enable the statistician to do a more thorough analysis.

The analysis of data using a computer would be very limited in accessibility without statistical packages. As discussed in Section II, there are many packages available for all levels of computers. It is these packages that bring the computer age to the data analyst.

Reports

Computers are a valuable clerical tool for producing reports. Numerical summaries and many tables can be formatted in a useful form and then printed with a high quality printer to produce statistical reports that eliminate much of the usual typing. This is especially helpful when lengthy summaries must be periodically updated.

Graphics

Statistics has always relied heavily on pictures as an essential part of data analysis. Computer generated graphics are the key explanatory and exploratory tool of many regression and distribution analyses. Graphics play an important part in goodness-of-fit, analysis of residuals, multiple comparison of means, and prediction based on regression. Most statistical packages include procedures for at least low resolution plots on a line printer. SAS Graph is a set of procedures that can produce high resolution plots of various types including scattergrams, histograms, United States maps, contours, and three-dimensional graphics. Figure 1 was drawn by an IBM 3287 plotter using SAS Graph. Figure 2 was drawn by a Zeta 1453 plotter using SAS Graph.

IV. THEORETICAL STATISTICS AND DEVELOPMENT OF METHODOLOGY

Computers are having an impact on theoretical statistics as well as applied statistics. Before the age of computers many techniques were developed to compensate for the lack of computing power. Some nonparametric methods were developed to be simple quick tests that approximated more powerful parametric techniques. With today's computing power, this is no longer a compelling reason to use or develop simpler substitute techniques. However, more emphasis is placed on nonparametric methods as alternatives to parametric methods when the necessary assumptions do not hold.

Some methods that were developed before computers were an attempt to approximate computationally complicated statistics with a simpler form. Such efforts are not as necessary today with the existence of computers

8

although some pre-computer hold-overs exist. A notable example is the Greenwood method of calculating the approximate variance of product-limit survival estimates.[8] Today the exact variance can be quickly calculated with a computer, but the approximate variance is usually reported in the literature.

The ability of the computer to generate data with known distributions makes it useful in several ways. New statistical methods can be evaluated using simulated data. The effect of misspecified distributions can be examined in parametric analyses. Evidence for or against suspected theoretical results can be derived from simulated data.

V. COMPUTERS AND CHANGING ROLE OF STATISTICS AND STATISTICIANS

The computer has gone far beyond its original function as a high speed calculator. It has caused increased development of applied and theoretical statistics in several specific areas such as logistic regression, proportional hazards regression, and stochastic processes. Development in these and other areas would certainly have been slow without the ability to actually perform the calculations for new methods.

An interesting development of the last twenty years is that many statisticians and researchers are reporting p values as opposed to a yes or no answer for significance at the 0.05 level. The p value is more informative because it identifies those tests which were close to significance, and perhaps deserve more attention. P values are difficult to produce using the tables in statistics books (t, F, chi-square tables) yet most statistical packages report p values and let the user decide what value of p is "significant". This availability of p values has contributed to their new and growing role in statistical reports.

The training of statisticians has been affected by the computer. Before the computer age many statisticians spent a large portion of their time performing arithmetic operations. Many a statistician became a wizard of numbers. With the coming of computers many statisticians were also trained as computer programmers. They would program many standard statistical methods and implement their own new methods. Today statistical programs across the country train statisticians in the use of statistical packages. Many courses are taught with all calculations performed by a package. This frees the student for interpretation of results and for exploration of alternative approaches.

The statistician of today has the tools to perform thorough analyses of data at an increased pace. He is freed from much of the drudgery so that he can better focus on the question under investigation. He is certainly in a position to be a more useful member of a research team.

VI. PROBLEMS

The age of the electronic computer has not come to the field of statistics without creating or exaggerating some problems. One of the most

serious problems occurs when the ease of using a statistical package causes a researcher to bypass the statistician. This is a problem when the researcher goes to a package expecting to learn statistics. Statistical packages all make the basic assumption that the user knows precisely what statistical techniques he wants. The package will then perform the calculations. The user who approaches a package expecting to be led to the proper analysis will be disappointed. This is not to say that each user must be a statistician; he only must be aware of the appropriate technique to apply to his data.

There are other problems related to statistical packages. Missing data are handled differently by different packages, and even by different procedures within a package. The user must be aware of what happens to missing data. Analysis of variance programs do not always provide clear and useful contrasts. Finally, the user may become a slave to a package in that he will only use those statistical techniques that are available in a particular package.

Another problem is the naive belief held by many that computers somehow purify a data set. This is not true. The computer cannot distinguish a wrong number from a correct number. It can only make editing decisions when directed by the user.

Analysis of data by computers often results in large stacks of printouts. This results in loss of focus on the main question and can be confusing to the researcher.

The user of computers must also be aware that computer arithmetic is not always perfect. Unidentified errors can cause incorrect analysis. For example, techniques that involve inversion of a matrix can lead to incorrect results if a near singular matrix is not recognized and handled properly.

Finally, the use of computers for statistical analysis can result in the loss of feel for the data. This almost intangible feel can identify inconsistent or impossible codes for data and even results that are aberrant. The specialization of steps in the analysis of data can lead to no one person having a good overall feel for the quality of the data and the quality of the results.

VII. CONCLUSIONS

The advantages of the computer in the field of statistics are numerous and far reaching. The analysis of data is faster, more accurate, and more thorough as a direct result of computers and statistical software. Many methods are practical only with a computer. Statistical theory and new methodology is developing at an accelerated pace due to the increased use of computers. Computers have even affected the relationship between researcher and statistician, allowing the development of more efficient research teams.

10

11. Kalbfleisch J.D., Prentice R.L.: The Statistical Analysis of Time Failure Data. John Wiley and Sons, New York, 1980

12. Kotz S, Johnson N.L., editors: Encyclopedia of Statistical Sciences, 2:93–100, John Wiley and Sons, New York, 1982

13. Kruskal W.H., Tanur J.M., editors: International Encyclopedia of Statistics. 1:59–74, The Free Press, New York, 1978

14. Lee E.T.: Statistical Methods for Survival Data Analysis. Lifetime Learning Publications, Belmont, California, 1980

15. Neffendorf H.: Statistical Packages for Microcomputers: A Listing, The American Statistician, 37:83–86, 1983

16. SAS Institute Inc.: SAS Graph User's Guide, Cary, N.C., 1981

17. SAS Institute Inc.: SAS User's Guide: Statistics, 1982 edition. Cary, N.C., 1982

18. SAS Institute Inc.: SAS FSP User's Guide, Cary, N.C., 1982

19. Sokal R.R., Rohlf F.J.: Biometry, 1st edition. W.H. Freeman and Company, San Francisco, 1969

20. Sokal R.R., Rohlf F.J.: Biometry, 2nd edition. W.H. Freeman and Company, San Francisco, 1981

21. Tukey J.W.: Exploratory Data Analysis, Addison-Wesley, Reading Massachusetts, 1977

PLANNING AND IMPLEMENTING A
SUCCESSFUL COMPUTER CAMP

John P. Anderson, Dean
UAB Special Studies
The University of Alabama in Birmingham
Birmingham, AL 35294

and

Virginia D. Gauld, Assistant Dean
UAB Special Studies
The University of Alabama in Birmingham
Birmingham, AL 35294

INTRODUCTION

UAB Special Studies, the continuing education unit for The University of Alabama in Birmingham, has completed a second summer of computer camps which were offered to youth throughout the state of Alabama. Each camp lasted for two weeks and was for commuter students. The two major factors contributing to the success of these camps were careful planning to assure that the goals set for the camps were attained, and timely implementation of the plan with check points set in order to periodically test for acceptable progress. The results of this planning and implementation were, in the first year, one computer camp filled to capacity and, in the second year, three computer camps filled to capacity. Even more impressive was the fact that, in the first summer, only microcomputers were used in the computer laboratory, while, in the second year, an additional laboratory was equipped with minicomputers to provide an expanded program for advanced computer students. During the first summer, forty students participated in the microcomputer camp. In the second summer, seventy-two students participated in two microcomputer camps and an additional forty students participated in one minicomputer camp, the first of its kind offered in the United States.

PLANNING

Approximately nine months before the target date for offering the first microcomputer camp, UAB Special Studies established a steering committee to begin the planning process for the camp. The goals which were established were: a) to successfully market a microcomputer camp to youth throughout the state of Alabama, b) to fill to capacity at least one camp, c) to provide a curriculum of such quality that students would be capable of simple programming on a microcomputer, and d) to familiarize youth with The University of Alabama in Birmingham so that they might attend the University as credit students in the future. The steering committee was comprised of staff from UAB Special Studies, faculty and staff from the UAB Department of Computer Sciences, and consultants from Duke University, who had successfully offered similar computer camps. From the

13

initial planning stages, the President of the University and the Senior Vice President of University College strongly endorsed the microcomputer camp. The Dean of UAB Special Studies and the Chairman of the Department of Computer Sciences served as active members of the steering committee.

Within the planning stages, the categories addressed were: a) curriculum development, b) instructor selection and training, c) logistical arrangements, d) budget, e) marketing plan, and f) evaluation. A timetable was established to identify dates by which tasks were to be accomplished by individuals so that accountability could be defined.

A. Curriculum Development

It was determined by the steering committee that students should have both classroom and laboratory learning experiences. While in the classroom, students should learn programming skills and, while in the laboratory, students should implement their programming knowledge. This classroom/laboratory time should be equal. Each student would have access to an individual microcomputer while in the laboratory and would have instructional assistance available at all times. For students having no experience in programming, BASIC language would be taught. Students having working knowledge of BASIC would be taught PASCAL. Textbooks were chosen for each of the languages.

During the first week, students would be assigned individual projects to complete and, during the second week, they would be grouped in teams and assigned group projects. Guest lecturers would be invited to speak during the classroom sessions in order to demonstrate practical applications of computers and to expose students to career options in computer science. Field trips to three major users of computer services were planned.

The computer laboratory would be open to students each day and on weekend so that they might work on their projects or utilize the computers in other activities. A laboratory assistant would be available at all times to assist students.

B. Instructor Selection and Training

Graduate students in the Department of Computer Sciences were chosen to be the instructors and laboratory assistants for each camp. Two students who were teaching entry level credit computer science courses were chosen as instructors. The chairman of the Department of Computer Sciences was responsible for training instructors and lab assistants. Consultants from Duke University were instrumental in orienting instructors to the curriculum. Based on their ability, students would be divided into two groups and assigned to an instructor. Each instructor would be responsible for daily classroom and laboratory sessions and would have the same groups of students throughout the microcomputer camp. Laboratory assistants would be assigned at a ratio of five students per assistant.

Instructors were responsible for developing the curriculum in specific detail to assure that each student completed an individual project by the end of the first week of the camp, and a group project by the end of the second week of the camp. Check points were established to evaluate student progress and to assist students during free lab time, if needed.

C. Logistical Arrangements

Each camp was held on the campus of The University of Alabama in Birmingham. A classroom was provided, as well as a laboratory facility to house the microcomputers, during the first summer camp, with an additional laboratory facility during the second summer camp to house the minicomputers. During the first summer, twenty IBM Personal Computers were rented so that each student had access to a computer. During the second summer microcomputer camp, 20 Apple II Plus microcomputers were available which had been purchased by the University. For the minicomputer camp, two Prime 2250 computers, twenty terminals, and four printers were provided by the Prime Corporation.

During the first summer camp, lunches and breaks were catered by the University hospital catering facility. In order to decrease the cost of the camp for students, during the second summer series of camps, plans were amended so that campers brought sack lunches. Snacks and drinks at breaks were provided by the University, as well as buses for field trips.

An awards banquet at a local hotel was planned for the first camp. Trophies were awarded to the camper completing the best individual project, the group of campers having the best group project, and the best all-around camper. Each camper received an attendance plaque for participating in the camp. Camp tee-shirts, text books, and supplies were provided to campers as part of their tuition. During the second summer, the planning committee changed the awards banquet to an awards ceremony held on campus, in order to decrease the expense of the tuition.

D. Marketing Plan

UAB Special Studies advocates direct mail as the primary method for marketing its continuing education program. Using the research of its marketing department, the staff designed and mailed a brochure to residences of individuals identified as prospects throughout the Birmingham area. Newspaper ads were placed in the local daily, as well as ads in three large metropolitan area newspapers in the state. Announcements were sent to school systems throughout the state. A course description was placed in the continuing education catalog which was mailed to 95,000 individuals and businesses in the Birmingham area. Radio advertising was planned during the second summer and Public Service Announcements were released during both summers. Word of mouth advertising was considered vital to the success of each camp and was fostered through computer courses offered for adults and youth in the noncredit program. Computer user groups were sent announcements regarding the camps, as well as appropriate periodicals and newsletters.

Each direct mail piece was coded in order to track the success of the mailing strategy. Persons registering by telephone were asked to identify how they learned about the camp. Their responses were recorded on the registration form using a predetermined response code.

E. Camp Budget

UAB Special Studies Noncredit Course Area operates on a self-support-ing basis. No state monies or university funds were used to underwrite the expense of these camps. During the planning stage, all expenses were identified which were necessary for the successful offering of the first camp. The total number of campers which could be accommodated was set at forty per camp. Based on the expenses and the number of campers per camp, a fee of $400 per camper was established for the first camp. During the second summer, a policy decision was made to lower the fee per camper. All expenditures were deleted which would not jeopardize the quality of the camp, thereby lowering the fee to $275 per camper.

F. Evaluation

Formative and summative evaluations were used to measure the success of each camp, based on the stated goals. Daily camper progress was evalu-ated by instructors and lab assistants. The schedule would be reviewed daily to evaluate progress. At the end of each camp, each student com-pleted a paper and pencil evaluation form. Each parent was also asked to evaluate the success of the camp. The steering committee met at the end of the camp to evaluate its success.

IMPLEMENTATION

A timetable was established in order to track the progress of the im-plementation of the plan. Persons responsible for the implementation were delineated and task completion was indicated. Regular meetings were held with faculty and staff to review the timetable and check for any slippage. Adjustments in staff and schedule were made on a daily basis in order to attain the goals set for each camp.

All evaluations indicated that parents and campers were satisfied with the quality of the microcomputer and minicomputer camps offered by The University of Alabama in Birmingham. The success can best be demon-strated by the fact that most of the campers participating in the minicom-puter camp during the second summer had participated in the first micro-computer camp. The response codes recorded on student registration of the second summer indicated that many students in the microcomputer camps had heard about the camp from participants in the first summer camp. It also should be noted that a second camp had to be offered during the sec-ond summer because of demand.

16

BENEFITS TO THE PUBLIC AND TO THE UNIVERSITY OF ALABAMA IN BIRMINGHAM

One of the mission statements of the University charges it with the responsibility for providing service to the public. During the emergence of the Information Age, The University of Alabama in Birmingham has demonstrated its concern that persons be educated in order to make the transition into this new lifestyle. Not just the youth who participated in these computer camps benefited from this experience, but also families, friends, and colleagues who were influenced by the education process. We believe that the public image of this university is that of an innovative institution offering educational services to meet the needs of the community it serves.

PERSONAL COMPUTERS IN SCIENTIFIC RESEARCH

Warren Jones
Chairman of Computer and Information Sciences
University of Alabama in Birmingham
Birmingham, AL 35294

ABSTRACT

This paper is intended primarily as a tutorial for researchers who are interested in investigating the role of personal computers in their research. A brief overview of the technical aspects of personal computers is given, followed by a description of some of the problems and limitations that the researcher can expect to encounter. Finally, some guidelines are given for selecting a personal computer system for use in research.
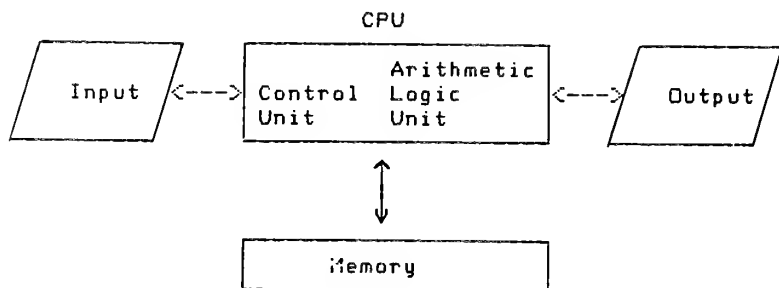
INTRODUCTION

Use of computers as a research tool is hardly new in the academic community. Large-scale computers, as well as minicomputers, have played a major role in the conduct of research. The recent advent of small-scale personal computers is not a fundamentally new event, but only the most recent chapter in the continuing story of technological advances, involving the development of lower cost, higher reliability computer systems. The appearance of these new low cost computing resources has attracted the attention of researchers who already have experience with the larger variety computers, as well as those who are interested in computers for the first time.

The purpose of this paper is two-fold. The first objective is to provide a technical tutorial to the subject of personal computers. Much of the technical introduction applies to computer systems in general. Secondly, we give some guidance in the selection of a personal computer for research applications.

GUIDED TOUR OF HARDWARE

Any computer system is made up of components which can be classified into two general categories: hardware and software. In this section we will discuss the hardware aspect. Hardware is that part of the system that you can see and feel: the video display, the console, keyboard, disk drives, etc. The hardware of a personal computer system is made up of five basic functional units. The components and their interrelationships are shown at the top of the following page. The basic building blocks can be described briefly as follows:

-- Input: Devices which allow the user to enter information into the computer. For a personal computer the mode of input is usually via the keyboard and video screen.

18

```
                            CPU
                   ┌─────────────────────────┐
  ┌─────────┐      │          Arithmetic      │      ┌─────────┐
 /          /      │ Control  Logic           │     /         /
/  Input   / <--->│ Unit     Unit            │<--->/ Output  /
└─────────┘       │                          │    └─────────┘
                   └─────────────────────────┘
                             ↑
                             ↓
                   ┌─────────────────────────┐
                   │          Memory          │
                   └─────────────────────────┘
```

-- Control Unit: This unit controls the logical processing of programs.

-- Arithmetic Logic Unit: The part of the computer that carries out the actual computations.

-- Output: Devices that display or print out information from the computer system.

-- Memory: That part of the computer system in which information must be stored before processing.

For a personal computer the input is almost always a keyboard, which operates in the same way as a typewriter, together with a video screen which displays the user input from the keyboard, as well as the response from the computer. The output is a printer if the user wants a paper copy (sometimes referred to as hard copy). Output also can be considered to be the disk drive which contains a diskette on which information can be stored for later use. Some personal computer systems have the disk drives built into the console (the IBM PC, for instance) and others have the disk drives as separate units (some Apples, for example).

The diskette itself, sometimes called a floppy disk, is a circular piece of plastic coated with a magnetic film. It resembles a 45 rpm record and operates in much the same way as a cassette tape recorder with respect to how the information is stored on the magnetic surface. It is enclosed in a plastic jacket because of its sensitivity to contamination. Information is stored on a diskette in concentric circles. The storage capacity of a diskette varies with the personal computer system. The capacity of the IBM PC is about 180,000-320,000 characters. The Apple is about 143,000 characters. The diskette is a medium for external storage of information. The main memory is internal to the console of the system.

Main memory is usually referred to as Random Access Memory (RAM). Any information which you wish to be processed by the computer must first be stored in RAM. The cost of RAM has been steadily decreasing and, therefore, for a given cost the RAM in a personal computer has been increasing. As of this writing, 64,000 memory positions (sometimes abbre-

viated 64K) is a common configuration. Memory is an important parameter of a computer since it determines the size of programs that can be run on the system. An important characteristic of RAM is its volatility. If the power is turned off for some reason, all information in RAM is erased and lost. One must always guard against this problem by periodically storing, onto diskette, information which you are entering during a data entry session.

Another variety of memory which is non-volatile is Read Only Memory (ROM). These memory units are constructed in such a way that the information is permanently stored. They are usually found in the system console near the RAM. They typically contain special programs supplied by the manufacturer such as special language processors and the like.

The Control Unit and the Arithmetic Logic Unit make up what is known as the Central Processing Unit or CPU. This part of the system is usually produced on a single chip of silicon. The ability to produce an entire CPU on a chip is the technological development that opened the door for the emergence of the personal computer. There are a number of chips on the market which are made by semiconductor companies and used by personal computer manufacturers. Some of the most popular chips are shown below.

Chip	Personal Computer	Word Size (in bits)
6502	Apple II Atari 400/800 Commodore PET	8
Z80	TRS-80 Model III	8
8088	IBM PC Digital Equipment Corp., Rainbow 100	16
MC68000	Apple Lisa	32

You will note one of the characterizing features of these chips is its word size. A word is the size of memory chunks that can be processed at one time. Since the hardware of a computer can deal only with numbers in the binary number system, memory and, hence, word size, is defined in terms of binary integers (bits) which can have values of 0 or 1. The first personal computers had a word size of 8 bits (also called a byte). More recently, personal computers with word sizes of 16 bits, a word size which in the past had been a defining characteristic for minicomputers, have become commonplace.

A complete personal computer system must consist of both hardware and software.

SOFTWARE

First, what is software? Briefly, it is a sequence of instructions which can be interpreted by a computer system and that is written to accomplish a specific task or set of tasks. The term software also is sometimes used synonymously with the word program. The difference between the two is that software is a program that is written for use by more than the programmer, usually a wide public application. In order to avoid having the computer user work directly with the hardware and the binary number system, software, called the operating system, has been developed. In general, each computer vendor has developed his own version.

An operating system has been called the chief executive that manages and integrates all the resources which make up the computer system. All commands entered at the keyboard are processed by the operating system. It also controls language processors, such as BASIC, PASCAL, or others, allowing users to write programs. It is important to be aware of operating systems since many programs which are available for purchase are developed by software companies or individuals and are dependent on a particular operating system environment.

Because of this problem of transferability, one should be aware that there are operating systems that can be installed in more than one manufacturer's computer. Some of the most popular are CP/M, Unix, and MSDOS. Because of the obvious wide market potential, software developers will frequently write their software for one of these operating systems.

Although the situation will no doubt improve in the future, it is also true that the recording format for diskettes differs from computer manufacturer to manufacturer. For example, this means that a program which was written in BASIC for one computer and stored on a diskette cannot be placed in the disk drive of another computer and run, even if the same dialect of BASIC resides in the second computer. The following table shows the variations in recording format across vendors. A track is one of the concentric circles on which binary information is recorded. A sector is one section of a track.

Personal Computer	Number Sectors	Bytes/ Sector	Number Tracks
Apple II(DOS 3.3)	16	256	35
IBM PC (DOS 1.1)	8	512	40
TRS-80/III	18	256	40
Zenith Z90	10	256	40

One way to solve the problem of transferring software from one system to another is to establish a communications link between the two computers or with a common computer.

COMMUNICATIONS

The idea of computers communicating over telephone lines or even sat-ellite links is not new with personal computers. Minicomputers and large mainframe computers have been involved in computer networks for a number of years. There are two modes in which this may be done, dumb terminal and intelligent or smart terminal mode. Dumb terminal mode: In this mode, the personal computer can be used as a terminal, communicating di-rectly with the other system. Intelligent terminal mode: This mode per-mits dumb terminal mode but, in addition, allows the user to make use of the local power of the personal computer by permitting local files of data or programs to be transmitted to the external system or vice versa. Both modes require a hardware device called a modem (short for the two words modulator demodulator) which connects the computer to the telephone line. There are products on the market which can be additions to a personal com-puter system permitting communications links to be established to other computers over standard telephone lines. Additional hardware must usually be added to the console in the form of a printed circuit board, as well as software usually supplied on a diskette.

With this brief technical background we conclude with some guidelines that should be useful in the selection of a personal computer for a re-search application.

GUIDELINES FOR EVALUATION OF PERSONAL COMPUTER SYSTEMS

The following guidelines are not listed in a priority order, with the exception of the first. It should be emphasized that they are only guide-lines and should not be elevated to the status of hard and fast rules. The use of these guidelines, together with common sense, should result in a reasonable choice of systems.

1. Probably the most important point to remember is that you should be guided by the available software which meets your needs. Software directories are available for all kinds of applications. The best hardware system is of little use to you if none of the programs you need will run on it.

2. Check for local sales and service. This guideline can be interpreted in one of two ways. First, you should check to see if your organiza-tion has a policy on the purchase of personal computers. Many do. Usually these are developed with the idea of availability of internal maintenance capabilities. If no policies exist in your organization, you should check the local community for computer stores available for service and consultation. Computers do break down and any soft-ware you buy will generate questions about usage.

3. Allow for expansion. First time computer users almost always expand their system during the first few years far more than they expected.

4. Check the system for documentation. Good documentation in the form of comprehensive manuals is an excellent indicator of a quality pro-

duct. Documentation also will help you determine the features and limitations of the system.

5. Test the system yourself. A system can look great on paper, but the story may very well be different when you actually use the system. A full-scale demonstration also will suggest further questions you had not considered earlier.

6. Beware of new products. Almost any new product goes through a shake-down phase. This is true of hardware and software. This is not to say that new products should not be considered, but they should be carefully assessed. Also, the availability of software should be a prime consideration in the evaluation of new hardware systems.

7. Do not rush into anything. Haste greatly increases the probability of an unpleasant result.

8. Check for quality engineering. Cheap construction or sloppy work in any area of the system is a sign of poor quality throughout the system. Be on alert for poor quality in the components with moving parts, especially printers. Again, look for poor quality or incom-plete documentation of both hardware and software.

9. Purchase a system that meets your needs. Be on alert for vendors who would reshape your needs to fit their package, rather than providing a product with the flexibility to meet your needs.

REFERENCES

1. Jones, Warren, Bobbie Jones, Kevin Bowyer and Mel Ray, Computer Literacy: Programming, Problem Solving, Projects, Reston Publishing Company, 1983.

2. Ableson, Philip and Mary Dorfman (editors), "Computers and Electron-ics," Special Issue of Science, February 1982, Vol. 215, No. 4534.

MICROCOMPUTERS IN SPORTS MEDICINE

Kennon T. Francis
*University of Alabama in Birmingham
Division of Physical Therapy
RTI Building, Room B-41
Birmingham, AL 35294*

INTRODUCTION

An important attribute of sports medicine as an applied science is that, as a relative new discipline, it challenges the abilities of traditional scientists with diverse backgrounds and interest. The biochemist, traditional physiologist, physical therapist, and orthopaedic specialist, to name a few, find opportunities to bring their own special talents to bear upon the fundamental processes which are involved in the function of the body's systems that have been altered by physical activity.

Computers have long been used by each of these specialists for statistical analysis in research projects. The introduction of microcomputers, which are inexpensive enough to become a personal possession, has facilitated innovative new uses and has provided enormous resources at their fingertips. This has not only increased reliability and efficiency of data collection and data reduction, but productivity as well (1, 2). The new microcomputers cost far less than mainframe computers, are portable, and, with the simplicity of programming in Basic, can be programmed to handle complex equations and formulae associated with many physiological processes. Additionally, they can be used to keep records, assemble and reduce large quantities of data, and provide organized graphic or numerical outputs to the user. All of these attributes have aided in the computerization of sports medicine (3).

Computer software is now available and is rapidly being incorporated into human performance laboratories, adult fitness and cardiac rehabilitation programs, sports medicine clinics, fitness clubs, and private fitness evaluation services (1). Computer technology is changing so rapidly, and its applications are so numerous and diverse, that it would be impossible to characterize every computerized sports medicine system. But a look at a representative use of microcomputers in the exercise physiology laboratory in Physical Therapy at the University of Alabama in Birmingham may help illustrate the many applications that are possible. It is hoped that the ideas presented here can be adapted for use in other types of settings and by other scientific disciplines.

The following is a description of the use of a microcomputer in an exercise physiology laboratory that is used in the development of individualized aerobic fitness programs. The purpose of this paper is to identify the many ways a microcomputer has been integrated into the various procedures, and how it facilitates the development of a fitness program.

The initial steps in the development of an individualized fitness program is to obtain data from three general areas. These include 1) an

initial fitness level, 2) body composition, and 3) psychological profile. Each of these tasks, if done properly, requires unique application of inherent physiological phenomena and should be emphasized by quantitative rigor using specified mathematical models. Unfortunately, in the past, adherence to strict scientific principles using appropriate formulae and data bases applicable to each of these phenomena often was not followed. This was due to an exigency of time and the inability to rapidly process data in a clinical setting. One of the attractive features of the microcomputer is its rapid mathematical manipulations that can provide fast data processing "on site" and provide immediate graphic and/or numerical displays for quick evaluation and interpretation. Figure 1 shows the use of a microcomputer in the three primary steps in fitness assessment and the subsequent exercise prescription.
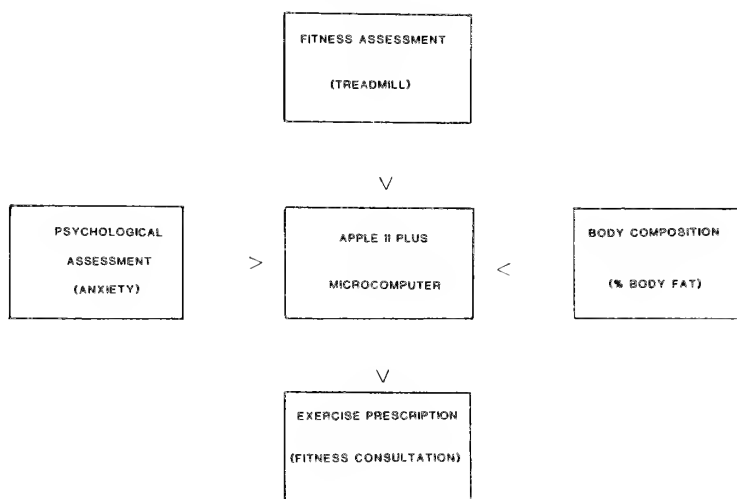
Figure 1. Flow chart showing typical use of microcomputer in sports medicine.

FITNESS ASSESSMENT

The goal of the initial fitness assessment for an exercise prescription is to determine maximal oxygen consumption (abbreviated VO2 max.) Oxygen consumption during exhausting work is not only the best single physiological indicator of the capacity of a man or woman for sustaining hard muscular work, but it is also the most objective method by which one can determine the physical fitness of an individual as a reflection of the function of the cardiovascular system (4). The VO2 max is determined most frequently during work on a motor driven treadmill. It has been shown that a linear function change occurs in oxygen consumption and heart rate with increasing work. Because of this relationship, heart rate is used to

estimate oxygen consumption. The popular Bruce Test (5) shown in Table 1 uses the duration of the test in minutes to determine oxygen consumption in milliliters per kilogram body weight. The formulae to calculate VO2 max using the results of the Bruce Test are:

Estimated VO2 max

men ---- milliliters O2/Kg body weight/min.= 2.94 (minutes) + 7.65

women -- milliliters O2/Kg body weight/min.= 2.94 (minutes) + 3.74

The microcomputer is ideally suited to graph the results of the test and calculate VO2 max using these formulae. A typical graphic representation of the results of the Bruce Treadmill Test is shown in Figure 2. The results of the test may be displayed or stored in an individualized data file for subsequent use in exercise prescription.

TABLE 1

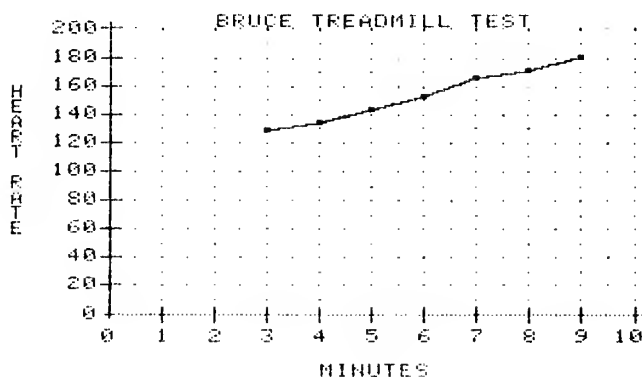| The Bruce Test: Varying Speed and Grade Treadmill Test					
		Energy Requirements			
Test Phase	Duration min	METS	VO, ml/kg/min	Speed (mph)	Grade %
I	3	5	16-18	1.7	10
II	3	6- 7	23-25	2.5	12
III	3	8-10	28-34	3.4	14
IV	3	10-12	35-42	4.2	16

Figure 2. Computer graphics representation of results obtained on a fitness assessment test.

EXERCISE PRESCRIPTION

To be most effective, an exercise prescription must give specific, written instructions for the intensity, duration, and frequency of exercise (6). This can easily be performed by the microcomputer using appropriate formulae and the results obtained from the fitness assessment test.

Intensity of exercise: There is an intensity for vigorousness of exercise that is adequate to condition the muscles and cardiovascular system, leading to physical fitness without exceeding safe limits. This level of exercise is represented by a target heart rate zone. Determination of an individual's target heart rate zone is based on the maximal attainable heart rate exhibited on the fitness assessment test and the subject's resting heart rate. The target heart rate zone is calculated using 70-85% of the maximally attainable heart rate (6). For example:

Maximum heart rate (beats/min.)	= 180
Resting heart rate	= -60
	120
Conditioning intensity	= x70%
	84
Resting heart rate	= +60
Minimum training heart rate	= 144

Duration/Frequency: Duration is the amount of time allocated per exercise session. Exercise sessions should consist of a 5 minute warm-up period, a 30 minute stimulus period where the heart rate is maintained in the target zone, and a 5 minute cool-down period. The frequency of exercise refers to the number of exercise sessions per week that are included in the program. In order to increase VO2 max, it is necessary to exercise at least 3 times a week. The "type" of exercise is not as important as the intensity and duration of exercise. Aerobic benefit can be derived from any type of activity if the heart rate is maintained within the training heart rate zone for at least 20-30 minutes. A typical 12 week exercise prescription generated by the Apple is shown in Figure 3.

Body composition: Any program designed to improve fitness should also be cognizant of body composition. Body weight is generally divided into three components: bone, muscle, and fat. Lean body mass is composed of bone and muscle weight. A person has been traditionally classified as overweight if his or her body weight exceeds the weight that is standard for a person of the individual's sex, height, and frame size. These standard weight norms are obtained from tables based on population averages. A major deficiency of the standard height-weight table is inability to differentiate lean body weight from fat weight. Although a standard height-weight index has been widely used for determining "overweight" subjects, its utility for estimating fat proportions is limited. Exercise programs that involve exercise at least 3 times a week will alter the relative lean body weight/fat ratio. Hence, to take advantage of the positive aspects of fat reduction, it is important to be able to measure and predict the relative lean/fat content easily and rapidly throughout the duration of an exercise program.

```
NAME --> KEN FRANCIS  DATE -- 12/12/83

FITNESS LEVEL IS AVERAGE                      BODY COMPOSITION

MINIMUM TRAINING HEART RATE = 139    % BODY FAT = 12.6
TARGET TRAINING HEART RATE   = 157
DO-NOT EXCEED HEART RATE      = 169  BODY WEIGHT NOW IS ==> 159
*****************************
12 WEEK WALK/JOG PRESCRIPTION         DESIRED WEIGHT SHOULD BE

WEEK 1 WALK/JOG 3 MILES IN 30 MIN.    BETWEEN 162 AND 166
WEEK 2 WALK/JOG 3 MILES IN 30 MIN.
WEEK 3 WALK/JOG 3 MILES IN 30 MIN.
WEEK 4 WALK/JOG 3 MILES IN 30 MIN.    PRECISE NORMS HAVEN'T BEEN ESTABLISHED
---------------------------------
WEEK 5 JOG 3 1/2 MILES IN 30 MIN.     FOR ALL AGES. MOST EXPERTS AGREE THAT
WEEK 6 JOG 3 1/2 MILES IN 30 MIN.     THE IDEAL STANDARD UPPER LIMIT OF
WEEK 7 JOG 3 1/2 MILES IN 30 MIN.     BODY FAT SHOULD BE BETWEEN 16 & 19%
WEEK 8 JOG 3 1/2 MILES IN 30 MIN.     FOR MEN ,& 22-25% FOR WOMEN.
---------------------------------
WEEK 9 JOG 4 MILES IN 30 MIN.
WEEK 10 JOG 4 MILES IN 30 MIN.        ABSOLUTE OBESITY IS CONSIDERED TO BE
WEEK 11 JOG 4 MILES IN 30 MIN.        ANY AMOUNT GREATER THAN 20% IN MALES
WEEK 12 JOG 4 MILES IN 30 MIN.        AND 30 % IN FEMALES.
---------------------------------
```

Figure 3. Computer representation of an exercise prescription
and body composition analysis.

Anthropometric measures of skin fold fat are the most practical means to determine relative body fat. Skinfold measurements correlate well with the underwater weighing method and have several advantages: the necessary equipment is inexpensive and needs little or no space, and the measures can be obtained easily and quickly by anyone with a little training. Typical formulae for calculating body density using skinfolds are (4):

Adult Men: Body density = $1.1093800 - 0.0008267 [X3] + 0.0000016 [X3]^2 - 0.0002574 [X6]$

  X3 = sum of chest, abdomen, and thigh skinfolds (mm)
  X6 = age in years

Adult Women: Body density = $1.0994921 - 0.0009929 [X2] + .0000023 [X2]^2 - 0.0001392 [X6]$

  X2 = sum of triceps, suprailium, and thigh skinfolds (mm)
  X6 = age in years

Percent body fat can then be calculated using the formula: (4)

  % body fat = $[(4.95/\text{body density}) - 4.5] \times 100$

This can subsequently be used to generate idealized weights for men and women.

Men   Desired weight = $\dfrac{[\text{weight} - (\text{weight} \times \% \text{ fat})/100]}{.84}$

Women   Desired weight = $\dfrac{[\text{weight} - (\text{weight} \times \% \text{ fat})/100]}{.77}$

A typical computer printout of this information that can be used for consultation with a patient in regards to his or her weight and body composition is shown in Figure 3.

PSYCHOLOGICAL ASSESSMENT

A complement of investigators (7, 8, 9,) have suggested that vigorous physical activity may be a useful "coping strategy" for reducing anxiety and tension. For example, it is fairly well documented that 20-30 minutes of vigorous exercise will decrease anxiety acutely for at least an hour post exercise. Not only does exercise apparently decrease anxiety for a short time period but a long time period as well. For example, Heinzelman et al., (9), in a study of the effects of physical activity as a primary prevention of heart disease, reported that males assigned to the "active" group had more adequate sleep and rest than their control counterparts. The "active" men reported lower perceived stress and tension levels and experienced greater feelings of better health and increased stamina and vigor than the more sedentary controls. Therefore, monitoring a subject's emotional status before, during, and following an exercise program can be a very beneficial positive feedback mechanism to motivate the subject and decrease the attrition rate of exercise programs.

There are many commercially available pencil and paper tests to determine an individual's emotional status. These tests can either be hand scored (which can be time consuming and arduous) or sent to the originating organization for scoring. This takes time and, because of this, these important variables usually are not assessed. The microcomputer is ideally suited for scoring and rapid transmission of the results to the subject. The results may be graphed or presented in numerical format. An example of a print-out of the results of a psychological test utilized in this laboratory is presented in Figure 4.

SUBJECT NAME : KENNON FRANCIS

DATE : 12/12/83

TENSION/ANXIETY SCORE   10

DEPRESSION/DEJECTION SCORE   22

ANGER/HOSTILITY SCORE   18

VIGOR SCORE   13

FATIGUE   10

CONFUSION SCORE   11

....

TOTAL MOOD DISTURBANCE SCORE 58
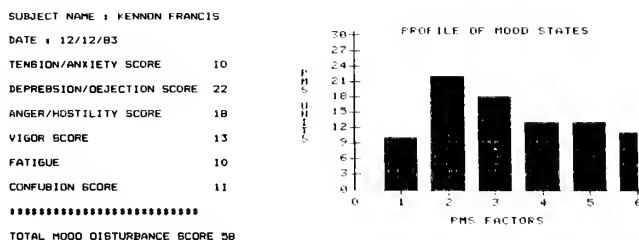
PROFILE OF MOOD STATES

PMS FACTORS

FIGURE 4. Computer representation of a psychological test (profile of mood states).

The efficiency and versatility that is possible with microcomputer technology are making sports medicine expertise available to a fitness-conscious public. The microcomputer now allows us to evaluate fitness parameters, carry out time consuming calculations, and present the results

in a graphic, numerical, and interpretative format that can be easily understood. The computer allows efficient data reduction and an individualized approach to each subject's exercise needs, resulting in an effective, yet safe, exercise program.

REFERENCES

1) Moore, M. The computerization of sports medicine. *Phys. Sports Med.* 9:118-127, 1981

2) Tidball, C.S. and Shelesnyak, M.C. (editors). Frontiers in Teaching Physiology: Computer Literacy and Simulation. Bethesda, MD., *Am. Physiol. Soc.*, 1981

3) Cordain, L., Johnson, C., and Ruhling, R. Description of a low cost microcomputer system interfaced to exercise stress testing equipment. *Res. Quart. Exer. Sport.* 53:73-77, 1982

4) Pollock, M.L. and Schmidt, D.H. Measurement of cardiorespiratory fitness and body composition in the clinical setting. *Comp Therp.* 6:1227, 1980

5) Exercise Testing and Training of Apparently Healthy Individuals: A Handbook for Physicians. *Am. Heart Assoc.*, New York, 1972

6) Guidelines for Graded Exercise Testing and Exercise Prescription. 2ed., Lea and Febiger, Philadelphia, 1980

7) Francis, K.T. Psychological benefits of exercise. *Cardipulm. Sect. Quart. A.P.T.A.* Winter, 1981, pp 2-4

8) Francis, K.T. and Carter, R. Psychological characteristics of joggers. *J. Sports Med.* 22:386-391, 1982

9) Heinzelmann, F. and Bagley, R. Response to physical activity programs and their effects on health behavior. *Pub. Hlth. Reports.* 85:905-911, 1970

MICROCOMPUTERS IN ACADEMIA

W. Donald Fattig
Department of Biology
University of Alabama in Birmingham
Birmingham, AL 35294

INTRODUCTION

In the 1950s and 1960s it became fashionable to speak of the "information explosion" occurring in the sciences. As new fields of inquiry and study arose, journals spilled out the findings at a rate which both intimidated and excited scientists.

The expanding influx of microcomputers into academic settings at all levels has precipitated a new challenge in American education. This trend has both similarities to and marked differences from previous technological educational "innovations" which promised fundamental change in the way that people would learn. As was the case regarding educational television and "reading machines", the advance publicity regarding anticipated outcomes of computer assisted instruction (CAI) was liberally sprinkled with hyperbole and prognostications in the absence of any factual underpinning. Perhaps the most striking similarity between television and microcomputers is that a relatively cheap device is making its appearance simultaneously in the classroom (the place that tradition says is where formal learning occurs) and the home. At the college level, at least three postsecondary institutions have announced plans to provide entering freshmen with their own microcomputers at the time they matriculate, with the intention that they keep them close by throughout their college career. (In fact, many more institutions already provide students with terminals or microcomputers in dormitories, on loan from libraries or media centers, or in some similar fashion.) In many homes, the microcomputer is becoming the focal point of after-work or after-school activity.

There is at least one fundamental difference between the arrival of television and that of microcomputers onto the American sociological scene. Television, whether in the home or school, is a passive pastime, with the "user" only "receiving" and processing that which someone else has "sent". The microcomputer, however, is a truly "experimental" device that requires "user" interaction. In its least sophisticated applications (games, mere "page flipping" of canned information), it is not much different from a television. But, a cursory survey of available computer software or observation of students actually using the device reveals that such uses are not the significant feature having implications for educators and students.

By the spring of 1982, 35% of U.S. public elementary and secondary schools had microcomputers; by the end of 1983 over 146,000 microcomputers are expected to be in use in the public schools (National Center for Educational Statistics 1982). An advanced placement test in computer sciences is being developed by the Educational Testing Service, to be admin-

istered to high school seniors for the first time in May 1984 (Watt 1983). And now there are some tentative answers to the question of effectiveness. Bracey (1982) has summarized James Kulik's analysis (U. Michigan) of 51 individual research studies on students using CAI in grades 6-12. The results indicate that CAI improved students' retention (when tested later) and that it can also improve the speed of learning a particular amount of material. The studies on effectiveness of CAI surely will continue, but they will be conducted in the future in an environment of widespread microcomputer usage at all levels.

A consequence of the broad-based introduction of microcomputer usage for a variety of purposes at the precollege level is that increasing numbers of entering students will enter higher educational institutions having familiarity with microcomputer use (Braun 1980). In response, according to predictions quoted by Magarrell (1983), by 1985 there will be 20 times the number of microcomputers in use on American college campuses as there were in 1980, and Professor Alfred Bork of the University of California at Irvine has said that within 20 years computers will have replaced print media as the primary mode of providing education to students.

COMPUTER ASSISTED INSTRUCTION APPLICATIONS

Drill and review is a widespread educational use of microcomputers. In tutorial mode specific facts or definitions are presented and the student later is asked to associate terms or concepts, recognize definitions, or to give some appropriate response. If the response is incorrect, the specific item is reinforced by review of previously presented information or with an alternative explanation. This is followed by testing again for the correct response. Often the student cannot move ahead to new items until proficiency is demonstrated.

Microcomputers are ideal for many topics that are mastered traditionally by recall and association. Examples include definitions of terms, learning hierarchically arranged lists, and recognition of graphically presented items. The programming involved is not complicated, usually, and the microcomputer allows learners to proceed at their own pace. The "instructor" in this case never wearies or becomes impatient with slower learners.

Spain (1983) has emphasized the value of microcomputers in simulating biological processes which cannot be studied in the laboratory because they occur over long time spans, or involve large populations, or require expensive apparatus. Any life process that can be reduced to mathematical equations can be "modeled" using a microcomputer. Specific examples include chemical processes having rate constants, predator-prey interactions, selection against genes in populations, and biological growth processes. Use of a computer simulation which allows the student to make different assumptions by changing known variables and observing effects on the simulated process, emphasizes its dynamic nature and parallels actual laboratory experimentation. At Michigan Technological University, Spain teaches an undergraduate biology course in microcomputer modeling in biol-

ogy; the problems chosen for simulation are those in his text (1982). Physiological processes lend themselves especially well to microcomputer simulation, and programs have been written for the glucose tolerance test, cardiovascular system mechanics, and axon action potentials (Randall 1980), among others.

Williams (1983) has discussed the use of "adventure games", a popular non-academic pastime, as educational strategies. The key feature of an adventure game is solution of a problem or series of problems in order to gain a reward. Williams uses the same approach in the program "Polymer-lab" to teach college seniors and graduate students how to identify polymers; another program of the sort ("Limnology Adventure") leads students through a limnology field trip, complete with planning of equipment to be taken, sampling in the field, and analysis of collected data. The use of simulation and games as educational devices involves planning of objectives and content, followed by programming and production; often accompanying textual materials must be developed to direct students in the use of the CAI package (Anderson 1983).

Software for college-level science education is available from a number of commercial vendors, individuals who have written programs that are used locally, and certain non-profit organizations. Perhaps the best known of the latter is CONDUIT, an NSF-sponsored clearinghouse for CAI materials located in Iowa City, Iowa. CONDUIT solicits CAI programs from authors in academic settings, gives assistance in their refinement and modification for use on several different microcomputer systems, and disseminates the units to users at relatively low cost. The modules are field tested and reviewed prior to release, helping to assure high quality. Well-designed student guides are included in many of CONDUIT's packages, and a wide disciplinary range is represented in the units available. CONDUITS's distribution of CAI materials has doubled in the past year (Peters 1982), an indicator of rapidly increasing use of CAI on campuses. A current CONDUIT project supported by The Fund for the Improvement of Post-Secondary Education (FIPSE) engages teams of authors who are developing computer based modules specifically designed for introductory courses in biology, chemistry, physics, and psychology.

TESTING

Microcomputers may be involved in the testing process in several ways. Testing may be done on the computer itself via keyboard inputs by students or with the use of a light pen which can be touched to the CRT screen. Responses may be saved on diskette and the test results included in the student's record. At the end of testing the student's score can be displayed on the screen immediately, or a printed evaluation can be reproduced. Depending on the computer program used and the test construction, areas of inadequate performance may be identified for guidance or review by the student.

If equipped with an appropriate peripheral device, the microcomputer can function as a testscoring machine. Using optical scanning techniques,

answers coded in pencil on a standardized form can be scored and a printout generated for the instructor. Various statistical treatments of scores are possible and an item analysis can be produced for the test.

Another use of microcomputers in testing is the generation of the printed test itself from a large data bank of questions. I have developed a 3000 item question bank for use in my large-enrollment introductory biology courses. Questions to be printed are chosen from a master list and their descriptors entered sequentially at the keyboard. A test heading is automatically printed and the chosen items then selected from diskette, sent to the printer, and numbered sequentially. Using an Apple II microcomputer, a master copy of a 120 item test can be created in less than an hour. Items can be edited or deleted from the files and new questions added using word-processing software. This approach saves time in test construction, permits frequent updating of test items, eliminates proofreading, and allows make-up exams to be created easily. It combines features of data management and word-processing in relation to an instructional task.

DATA MANAGEMENT

The scientific academic mission includes, necessarily, data management and analysis. The typical problem is: (1) organization of data; (2) storage; and, (3) statistical treatment. The ability of microcomputers to aid in all these tasks is based on several features of their design and function, as well as the design of the software used.

First, computers are devices which follow logical command sequences. Therefore, the organization of data is largely a matter of file structure construction by a particular program.

Once provided a set of rules for organizing data, individual items can be sent easily to a diskette having large storage capacity. Approximately 130,000-320,000 characters may be stored, depending on the microcomputer used. If Winchester-type disk drives are used, storage may be amplified to 20 million or more characters.

Statistical analysis of data is a function, again, of the software used, but most standard statistics can be produced using today's microcomputers. This valuable capability results from the microcomputer's accurate performance of iterative arithmetic operations. Consequently, data files may be constantly updated and otherwise tedious statistical analyses performed rapidly on the accumulated data. Neffendorf (1983) has recently compiled a useful list of statistical packages for microcomputers that identifies specific statistical tests supported by each package.

LABORATORY DATA ACQUISITION

With appropriate analog to digital interfaces, data from common laboratory instruments (pH meters, spectrophotometers, etc.) may be sent to a

microcomputer. Since many modern instruments already include built-in microprocessors it is a simple matter to route the digital information to an attached microcomputer system, where the data can by displayed, organized, stored, and analyzed. Such a capability allows unattended accurate data acquisition in long-term experiments and intermittent sampling from several instruments can be accomplished using a single microcomputer system.

Although the most obvious application of analog to digital techniques is in the research laboratory, it is also appropriate in the teaching laboratory involving experimentation. And, it is an integral part of "voice synthesis" techniques that give microcomputers the ability to "speak" in addition to the customary screen display.

WORD PROCESSING

Many software packages for word processing are available for microcomputers, and, judging from the software promotions and sales, this application is clearly one of the most popular personal computer uses. In academic settings word processing involves letter and memorandum writing, preparation of grant proposals, exams, bibliographies, manuscripts and reports, and any other use involving printed material. In many departments, graduate students write their theses using microcomputers as word processors, and the secretarial staff has completed the conversion from electric typewriters. Winkel (1983) recently has reviewed the many uses of word processing in academia.

An extension of word processing is the formation of Local Area Networks (LANs) linking several microcomputers and permitting transmission of documents from one station to another. "Electronic mail" is common now in many business organizations and its use is on the rise in academic settings.

NETWORKS AND DATABASES

Within the past year there has been a rapid explosion in the use of microcomputers to access large national databases via telephone networks. Traditionally the exclusive province of the institution's library, it is now possible for faculty members and students to conduct literature searches on large databases like MEDLINE, Chemical Abstracts, and Biological Abstracts. Relatively inexpensive database networks include Knowledge Index (Dialog Information Services), and BRS/After Dark (Bibliographic Retrieval Service). A modem (modulator/demodulator) interface is required to communicate digitally over telephone equipment, and appropriate software for the microcomputer enables the user to "capture" the retrieved information in the distant database. In some cases this includes abstracts of articles as well as citations.

Networking and database searching with microcomputers simply means that much of the knowledge of the world is now personally accessible on demand.

SUMMARY

The burgeoning use of microcomputers in academic science is a consequence of many factors, including: increased usage in precollege settings, enhancing student readiness for and expectation of college usage; increased campus availability to faculty members having diverse computing needs; versatility of the devices, largely the consequence of development of special hardware items and an explosion in the quality, quantity, and functional diversity of available software; incorporation of microprocessor technology into laboratory instrumentation; and function as communications devices, accompanied by recent accessibility of large searchable databases of academic interest. Many of these same factors will influence future uses of microcomputers. The development of faster microprocessors, larger memories, better printers and storage devices, together with continuing pricing competition, will play roles, too. But the factor likely to be judged, in retrospect, most significant in the academic microcomputer revolution will probably be the rate at which these devices have gained widespread acceptance by humans in serving their diverse academic needs.

REFERENCES

Anderson, Ronald E. 1983. Innovative Microcomputer Games and Simulations. *Simulation and Games* 14 (1):3-9.

Bracey, Gerald W. 1982. Computers in Education: What the Research Shows. *Electronic Learning* 2 (3):51-54.

Braun, L. 1980. Computers in Learning Environments: an Imperative for the 1980's. *BYTE: The Small Systems Journal*. 5:6-10; 108-114.

Magarrell, Jack 1983. Microcomputers Proliferate on College Campuses. *Chron. Higher Ed.* XXVI (22):9.

Neffendorf, Hugh 1983. Statistical Packages for Microcomputers: A Listing. *The Amer. Statistician* 37 (1):83-86.

Peters, Harold B. 1982. From the Director's Desk: New Packages. *Pipeline* 6:2-3.

Randall, James E. 1980. *Microcomputers and Physiological Simulation*. Addison-Wesley Publishing Company, Inc., Reading, Mass.

Spain, James D. 1982. *Basic Microcomputer Models in Biology*. Addison-Wesley Publishing Company, Inc., Reading, Mass.

Spain, James D. 1983. Computer Applications in College Biology. *Collegiate Microcomputer* 1 (2):129-132.

Watt, Dan 1983. The Push for Standardization. *Popular Computing* 2 (11): 65-67.

Williams, Fred D. 1983. Educational Uses of Adventure Games. *Collegiate Microcomputer* 1 (1):25-32.

Winkel, Brian J. 1983. Word Processing for Academia. *Collegiate Microcomputer* 1 (2):124-128.

_____ National Center for Educational Statistics 1982. Instructional Use of Computers in Public Schools. *NCES Report* 82-245. Washington, D.C.: U.S. Department of Education.

ACADEMIC LIBRARIES AND THE COMPUTER
Sherrida A. Jassmann
Online Services Coordinator
Science & Technology Department
Ralph Brown Draughon Library
Auburn University, AL 36849

INTRODUCTION

A library, commonly thought of as being a collection of books and other literary material, is a direct result of the invention of writing. Traditionally, librarians have been regarded as "keepers" of books. For over five centuries the book has been the most unique method for storing, transporting, and transmitting information. The books collected in the first libraries were carved into clay and stone tablets or painstakingly handwritten onto papyrus rolls. Few in number and with restricted access, these early collections of books, or academic and research libraries, were typically at the centers of learning and scholarship in the ancient world, as was the famous Alexandrian Library.

With the invention of movable type, or the Gutenberg press, the book became much easier to mass-produce. As books become more numerous, so did libraries. The earliest libraries in America were established with the first colleges or universities, for example the library begun at Harvard University in 1638. For more than a hundred years in this country, the academic library has played a key role in scholarly communication by acquiring, preserving, and disseminating information through the written word in the form of books and journals.[1]

Scientific and scholarly research is cumulative, building upon previous work. In what is now called the "Information Explosion", the scientific literature grew from some one hundred journals at the beginning of the nineteenth century to some 30,000 journals by the 1960's.[2] Since ready access to the literature within a field is critical to the endeavors and success of the researcher, each of the disciplines in the physical, biological, and social sciences started, what are now, massive indexing and abstracting services, like *Chemical Abstracts*, *Biological Abstracts*, and *Psychological Abstracts*.

These manually produced indexes, abstracts, and the catalogs in libraries, all important links in the chain of scholarly communication, were being severely strained by the aforementioned "Information Explosion" begun in the 1950's. For both the researcher and the librarian, the problem of quick and ready access to this "Information Explosion" appeared insurmountable, until the application of the computer to bibliographic control. Following World War II, in conjunction with the unprecedented public support of science, federal funding was also made available for research and development (R & D) into computer-based information storage and retrieval systems.[3]

THE HISTORY

In the early 1950's, James W. Perry at the Massachusetts Institute of Technology, along with Allen Kent, P.R. Bagley and others, investigated entering information into a computer so that it was not only stored, but also retrievable from various access points. However, batched bibliographic search systems proved to be technically feasible long before the originally proposed, and now in use, online search systems. The delay in the development of online interactive systems was largely caused by limited technology and associated costs.

The first step for the user in utilizing a batch search system, was to state or write the information request so that it was clearly communicated to a trained search analyst. The analyst then formulated a complete search strategy from the key words or subject descriptors contained in the information request. This search strategy was entered in its entirety into the computer. Several hours or even days later, the computer processed the information request giving only the final result, a bibliography of journal citations on the requested topic or subject of interest.

MEDLARS (Medical Literature Analysis and Retrieval System) was originally a batch search system started in 1964 by the National Library of Medicine (NLM). Six weeks was the general turnaround time, since both the user's request to NLM and the resultant bibliography from NLM were mailed. If the search strategy was wrong, or the results unsatisfactory, the process was repeated. For some types of information requests, batch searching was useful and had definite advantages over manually scanning *Index Medicus* and other paper tools. Batch searching, because of its shortcomings, was quickly abandoned as the technologies were developed and improved, making online searching possible.

The Advanced Research Projects Agency (ARPA) in 1965 contracted with System Development Corporation (SDC) to provide thirteen organizations with online access to a file of some 200,000 citations on foreign technology. In 1966, IBM developed an in-house online bibliographic search system. This IBM search system was the beginning of STAIRS, a system still in use by several organizations, like Bibliographic Retrieval Services (BRS), which was begun in 1977. Lockheed was awarded a contract from the National Aeronautics and Space Administration (NASA) in 1968 to develop an online retrieval system, which in the beginning was called RECON (REmote CONsole Information Retrieval Service), but later became known as DIALOG.[4] In 1970 the Lockheed DIALOG system was utilized to access the *Nuclear Science Abstracts* data base by researchers with the U.S. Atomic Energy Commission at Oak Ridge National Laboratory.

Beginning in the early 1960's, the producers of various indexing and abstracting services started using computers in the process of typesetting these paper tools.[5] Faced with constant exponential growth in the sheer number of journal titles representing various scientific fields, the producers were driven towards using the computer to print their paper indexes and abstracts because of greater cost-efficiency and increased speed in production. The results of such computerization fulfilled the original

intention of the producers by increasing both the efficiency and speed at which these paper bibliographic tools were published and distributed to libraries, other organizations, and individuals. Computerization also created a potential new product - a machine-readable file or data base. The machine-readable file could be loaded into an information storage and retrieval system on a computer for bibliographic searching.

By the early 1970's, the technology needed to make the online industry commercially viable was firmly established. This technology involved using remote terminal equipment connected to a time-shared computer through telecommunication networks like TYMNET or TELENET. Since bibliographic data bases are massive files of information, the continual reduction in the cost of computer storage was another factor which finished setting the stage for the birth of the online industry. Online storage is required not only for the bibliographic records themselves, but also for the inverted files that are created to provide multiple search access points.

Between the years from 1970 to 1972 the appropriate technology was extant for nationally available online retrieval networks, and the producers of indexing and abstracting services began to market their newly created data bases. This combination of factors proved an irresistible force to both Lockheed and SDC. With visions of profit, both companies gained the acquiescence of the original government contractors and extended access to their bibliographic search services to outside interested organizations, for example, libraries. Most of the available data bases on both services were created through federal funding like ERIC (Education Resources Information Center) from the U.S. Office of Education, NTIS (National Technical Information Service), and CAIN (CAtaloging and INdexing) file from the National Agricultural Library. Soon to be added were data bases from professional societies and other non-profit organizations like COMPENDEX, the *Engineering Index*, or PsycINFO, *Psychological Abstracts*. Lastly, data bases from the private sector appeared, like ENVIROLINE or ENERGYLINE, both from Environment Information Center, Inc., and ABI/INFORM (Abstracted Business Information) produced by Data Courier.

THE PRESENT

Today, libraries and the researchers who use them, have access to hundreds of data bases available through many kinds of online vendors, commercial enterprises, non-profit organizations, or government agencies. The online vendor buys from the producer the right to make the latter's data base publicly available through the vendor's host computer. The two parties usually strike a deal in which the producer either receives a flat annual fee or royalties based on how often the information is retrieved, or both.[6] Most of the data bases are bibliographic in nature, containing millions of references to journal articles, annuals, proceedings, conferences, theses, government documents or report literature, and books. Non-bibliographic data bases, for example numeric files with U.S. Census data, began appearing two or three years ago. The latest trend is towards full-

text files, or data bases made from inputting the complete texts of books or journal articles, such as the ACS (American Chemical Society) journal file.

There are many advantages to using an online information storage and retrieval system for bibliographic searching, for both the librarian and the academic researcher. An online system, as opposed to the batch system previously described, yields immediate results. As each subject descriptor or word is entered into the computer, the number of bibliographic citations containing the phrase or word is received back. The citations or postings are assigned a set number. Sets of references may be displayed to check for subject relevancy or combined to either broaden or narrow the search. The immediate answers to queries in online bibliographic searching can produce a dynamic feedback environment in which the results to one question are used to modify what is asked next.

Data bases cover a wide variety of subjects. Presently, there are more data bases in the physical and life sciences than there are in the social sciences and humanities. The following list of questions attempts to illustrate the many different kinds of information requests which can be answered through online bibliographic searching:

1. What are the nutritional requirements for growing catfish?

2. What studies have been done relating Personality Types A and B to stress, heart attacks, high blood pressure, and strokes?

3. Have any articles been published on "Quality Circles," a management technique?

4. In what industries has the application of robotics to assembly line production improved or eliminated hazardous working conditions?

5. What studies have been published on German-Soviet diplomatic relations during the World War II era, 1939-1945?

All of these questions could be searched easily online.

Author searching is permitted in many data bases. Other examples of access points searchable in some online files are patent numbers, registry numbers for chemical compounds, and SIC (Standard Industrial Classification) codes. In the specially created files by the Institute of Scientific Information, *Science Citation Index* or *Social Science Citation Index*, one can find online the latest papers citing a known "key journal article or other source" or a known leader in the field, like Barbara McClintock, recent recipient of the Nobel Prize for Physiology or Medicine. Another unusual file is, SUPERINDEX, which has, as access points, the indexes to many of the standard handbooks, annuals, and other reference works in the sciences. The purpose of SUPERINDEX is to be able to quickly locate the one handbook needed for phase equilibrium data or zinc toxicity levels.

Limiting a search by language, year, geographical area, or publication type is also possible in many data bases. In this way a bibliography can be produced containing only English language journal citations from 1975 to the present published in the United States. Retrospective searches are most often limited to the dates the files were begun, in the late 1960's to early 1970's, since that is when publishers started using the computer to produce the paper copy as previously explained. So if a researcher is looking for work done in the 1940's, a manual search of the appropriate paper indexes or abstracting services is still required. Two notable exceptions to this generalization are, the *Dissertation Abstracts* files which begins in 1861 and the GEOREF file (*Bibliography of North American Geology*) which currently starts in 1929.

Data bases are always more current than the paper indexing and abstracting services because the paper copy is produced from the machine-readable file. Most files are updated on a regular schedule, usually monthly. By the regular updating of a data base, Selective Dissemination of Information (SDI) service is possible. SDI service involves establishing a search strategy or profile to be stored in the system and searched whenever the data base is updated. A bibliography of the latest references on the desired topic is the result of SDI, or a monthly current awareness service.

Once the search strategy is executed and the final set of citations has been selected, the output or bibliography can be sorted on several parameters. It can be sorted by date, or title, or author, or a combination thereof. Unless, otherwise specified in the print command, the citations are printed in the order of "last in first out" so that the most current citations are always listed at the top of the bibliography.

The user has several options for the delivery of the bibliography or printout. In most cases a print command is entered which orders the computer to print the citations at the distant location of the host computer and then the bibliography is placed in the mail the following day with delivery in about a week. Ordering the computer to print the citations offline is the least expensive method. Another option is to display the citations online while connected to the computer. This works best with a printer; otherwise citations can be lost as the information is rapidly scrolled over the video screen. If a microcomputer is being used for online searching, the final set of citations can be "downloaded" to a diskette. After the user has disconnected from the host computer, the citations captured on the diskette can be sorted and otherwise manipulated with word processing packages and other software to more precisely meet the user's needs. The major impediments to "downloading" today are questions of legality and copyright which can only be resolved by the data base producers.

Preparation by both the academic researcher and the librarian is the key to a successful online bibliographic search. Many libraries require the researcher either to complete a search request form or to meet with a reference librarian for an interview, or both. In online searching, just as in working with the paper resources in a library, communication and

teamwork between the librarian with information skills and the academic researcher with subject expertise is essential.

After a search strategy is plotted, it is the librarian who keys it into the computer. In some libraries the researcher is encouraged to be present at the terminal as the librarian executes the search. This is so both the researcher and the librarian can take part in the dynamic interactive nature of online searching.

The cost of an online search is affected by many factors and varies greatly from library to library. A few libraries completely subsidize the service, offering free online searches when needed by the researcher. Most libraries, with already severely strained budgets, attempt to recover a part of the cost for providing online service from the end users or requesters. This charging policy is justified by the fact that unlike the paper resources in a library, which can be utilized repeatedly by many different users, the product of an online search is a uniquely tailored bibliography to be used exclusively by only one researcher.

The charges to the end user are based usually on the rates for computer and telecommunication connect time and the rates for citations displayed online and/or printed offline. These rates are established by the online vendors and data base producers. Connect rates range from $12 per hour to $300 per hour. Citation display or print rates start at 10¢ per record, with some averaging as high as 50¢ per record. Online search costs can range from a few dollars to several hundreds of dollars, depending on which and how many data bases are accessed, how lengthy the search is, and how much is displayed online and/or printed offline.

When the library's card catalog is consulted to locate the journals, books, or other documents cited in the bibliography produced by an online search, the researcher is again encountering the results of computerization. Most academic libraries produce the cards in their catalogs from massive data bases maintained by bibliographic utilities, like OCLC, Inc., or RLIN (Research Libraries Information Network). MARC (machine-readable cataloging) files which were begun in 1968 by the Library of Congress are the foundation of OCLC's nationally networked data base. OCLC member libraries share the cataloging records in the data base, inputting for and borrowing from the other member libraries. In Alabama, libraries access OCLC through the regional Southeastern Library Network, SOLINET.

A library can use the data base created from cataloging its books, journals, and other materials to automate and thereby improve many other functions and services. Through computerization circulation, acquisitions, serials, and interlibrary loan can all be made easier, faster, and more efficient. The card catalog itself can be replaced by an online version accessed through public terminals.

In accessing a nationally networked cataloging data base, like OCLC, interlibrary loan service is facilitated in two ways. First through OCLC, libraries which have a needed item can be quickly identified. The other is that through the network's electronic message switching capabilities

the request for the journal article or book can be instantly transmitted to a distant library. The document's delivery to the researcher is speeded by several days, thereby avoiding the delay which accompanies mailing an interlibrary loan request form.

The Network of Alabama Academic Libraries (NAAL) was formed in 1983 following a three-year study by the Alabama Commission on Higher Education. When the $1.1 million requested from the state legislature is appropriated, NAAL will become a statewide computerized network composed of the holdings of each cooperating library. In addition, once the materials are cataloged on computer, Alabama libraries can begin jointly purchasing materials, maximizing the potential for resource sharing.

THE FUTURE

In the future, faster document delivery service will result from rapidly developing technologies in communications and computer storage. As communication capabilities improve, through satellites, fiber optics, and other sources, telefacsimile transmission of entire journal articles, or even whole books and other documents, will become possible and cost-effective. Research and development into laser optical video disks for high-density computer storage continue to move forward.[7] As this technology is perfected video disks may become an economic competitor of microforms for the storage of large collections.[8]

Another future trend is the simplification of the query languages used in information storage and retrieval systems. This simplification is to make a system "user-friendly" so that the end user can be the searcher without aid from a trained librarian. DIALOG's Knowledge Index and BRS/After Dark, are examples of systems to be accessed by the end user through a microcomputer in the home or office.[9] Still to be determined is whether the end user, or researcher, needs or wants to search directly online systems and, if so, what kinds of systems will be successful.

There are some ominous notes in the future of online industries, especially in terms of cost for the academic researcher. The changing technologies have made it easier to put a price tag on information production and utilization. As the volume and profitability of the online industries has increased, "big businesses" have been attracted to them.

In 1980, BRS was bought by Thyssen-Bornemisza, Germany's largest steelmaker, and SDC was bought by Burroughs Corporation, a giant business machine and computer maker. DIALOG became a subsidiary company of its parent Lockheed in 1981. These companies are quite willing to test the information marketplace to determine what price levels can be sustained which will bring them at least adequate, if not, handsome profits.[10] At the same time, the U.S. government which has long supported the creation and maintenance of many data bases like ERIC, NTIS, and MEDLINE, is reducing its funding or completely cutting the budgets for some data bases. In some instances this is a complete reversal of national policy, which through the awarding of contracts has speeded the development of current

information technologies and has kept the prices of some files artifically low through subsidizing their substantial costs.

CONCLUSIONS

The computer is forcing the definition of a library to change from a place where books are collected, stored, and accessed to a place where information is collected, stored, and accessed. This purer definition encompasses all the mediums and formats utilized in a typical academic library today, printed books and journals, audio-visuals, machine-readable data bases, and so on. As a result of computerization, librarians are becoming more than just "keepers" of books, and are experiencing job title changes to information scientists or information specialists.

Regardless of the format of information in an academic library - books, journals, audio-visuals, or computerized data bases - the role the library plays in scholarly communication is not changing. Neither is the computer changing the role of the academic librarian, who still acts as an information facilitator for the research of the scholar. The computer is only a tool through which academic libraries and librarians can continue to fulfill their respective roles in scholarly communication.

REFERENCES

1. Battin, Patricia. 1982. Libraries, Computers, and Scholarship. *Wilson Library Bulletin*. 56 (8):580-583.

2. Price, Derek J. De Solla. 1963. *Little Science, Big Science*. Columbia University Press, New York.

3. Bourne, Charles P. 1980. On-line Systems: History, Technology, and Economics. *American Society for Information Science Journal*. 31 (3):155-160.

4. Miastkowski, Stan. 1981. Information Unlimited the DIALOG*TM Information Retrieval Service. *BYTE: The Small Systems Journal*. 6 (6): 88-108.

5. Burchinal, Lee G. 1978. Impact of on-line systems on national information policy and on local, state, and regional planning. In: *The On-line Revolution in Libraries*. (Kent, Allen and Galvin, Thomas J., eds.) Marcel Dekker, Inc., New York. pp. 75-84.

6. Kiechel, Walter III. 1980. Everything you always wanted to know may soon be on-line. *Fortune*. 101 (9):226-240.

7. Bell, Alan E. 1982. Recent developments in optical storage technology. *Nature*. 297 (5862):104-105.

8. Goldstein, Charles M. 1982. Optical Disk Technology and Information. *Science*. 215 (4534):862-867.

9. Tenopir, Carol. 1983. Dialog's Knowledge Index and BRS/After Dark: Database searching on personal computers. *Library Journal*. 108 (5): 471-474.

10. Pemberton, Jeff. 1981. The Inverted File (Regular Column). *Online*. 5 (1):6-7.

Notes

Notes

Publication and Subscription Policies

Submission of Manuscripts. Submit all manuscripts and pertinent correspondence to the EDITOR. Each manuscript will receive two simultaneous reviews. For style details, follow Instruction to Authors (see inside back cover).

Reprints: Requests for reprints must be addressed to authors.

Subscriptions and Journal Exchanges: Address all correspondence to the CHAIRMAN OF THE EDITORIAL BOARD.

BENEFACTORS OF THE
JOURNAL OF THE
ALABAMA ACADEMY OF SCIENCE

CONTENTS

ALABAMA'S MOUNTAIN ECOLOGY WORKSHOP:
A MODEL FOR CONSERVATION EDUCATION

Dan C. Holliman
Division of Science and Mathematics
Birmingham-Southern College
Birmingham, AL

In a camp hidden in the foothills of the Appalachian Mountains near Mentone, Alabama a consortium of educators and students gather each spring. Since 1978 this activity has attracted naturalists who are intrigued by the concept of "outdoor" education. Participants come from all walks of life--teachers, doctors, lawyers, space engineers, business people, homemakers, senior citizens, and youngsters. Each person comes with a desire to learn about man's place in the natural environment. The staff brings a broad range of expertise--botany, geology, zoology, history, education, and field techniques. Each teacher contributes a special interest, thus creating a "hands on" experience for their students.

Outdoor education is not a new concept in Alabama. In the early 1950's Blanche E. Dean, then a science teacher at Woodlawn High School, held the first nature workshop in the state. She was a zealous supporter of the affairs of the Alabama Academy of Science, and made significant contributions to the field of outdoor education before her death in 1974. Her workshops were held at Birmingham, Payne Lake, Shoal Creek, DeSoto State Park, Mt. Cheaha, Lake Coleman near Anniston, and on the Bon Secour River in Baldwin County. These were informal 3-day outings that she effectively created with a blend of the local fauna, flora, and geography of each unique area. Blanche exposed countless people to nature study, and inspired many youngsters to go into biology as a profession. It is from these early beginnings that the present day mountain ecology workshop had it's genesis, and is annually dedicated to her memory.

It is the intention of the Mountain Ecology Workshop to draw together those people with a common interest in nature. The staff, dedicated to the proposition that effective teaching and learning can occur out-of-doors, have demonstrated field expertise in the state of Alabama. Many are professionals published in their field, and are otherwise recognized by their peers.

The philosophy of the Mountain Ecology Workshop is four-fold:

1) to create a conservation ethic by using a humanistic approach. An attempt is made to show man's place in nature and how human values relate to a sound conservation ethic;

2) to teach environmental education by using a multidisciplinary approach. The areas of botany, zoology, geology, history, and other humanities are integrated into the subject matter;

3) to teach Alabama natural history by using knowledgeable instructors who are aware of environmental and cultural changes in the state; and

4) to teach that life on this planet depends upon diversity of many different forms of animals and plants. Every effort should be made to preserve living things and to appreciate their position in the ecosystem.

Alpine Camp, the site for the Mountain Ecology Workshop, is located near Mentone in northeast Alabama. This is a well-equipped field station with teaching and living facilities for approximately 100 people. Well-kept trails and secondary roads provide access to the study areas. Primitive camps can be reached by backpacking. It is in the center of the Upper Austral life zone and is conveniently situated for short trips into the Lower Austral. Geologically, it is well suited for studies of the structural aspects of the Appalachian foothills. The Appalachian Plateau embraces Cumberland, Sand, Lockart, Gunter, Brindlee, and other smaller mountains. This area includes the more broken and rugged portions of the Appalachian Plateau. It is bound on the northwest by the Tennessee River and on the southeast by the Coosa River. Except for several fish species, the aquatic fauna here is indigenous to both watersheds. Generally, it is too rough for extensive agricultural purposes, although there are numerous areas of good sandy loam soils that support some crops. Dairy farming, timbering, and limited coal mining areas interdigitate the mountainous region. Deep gorges and extreme slopes offer opportunities to examine patterns of ecological zonation much like that found in the northern U.S. and southern Canada. Many animals and plants that are commonly found in the north live here. Presently this area is being impacted by real estate development and multi-recreational use. During the spring and fall commercial lodges fill with tourists who are there to enjoy the climate. Botanists also come to study wildflowers and trees.

The Workshop is sponsored by the National Audubon Society, and is administered through the Birmingham Chapter affiliate. Through this organization the program is supported and publicized. On site, there are two administrative directors who are responsible for logistics, and an academic director who is in charge of the curriculum. Credit can be recommended for teacher certification. A youth program, with a graded curriculum, is taught by a qualified teacher. The three day camp occurs during late spring and is composed of a series of short courses. Each short course is approximately three hours long, and is limited to 8 to 12 students, depending upon subject matter and field logistics. During the camp each participant may select up to five different short courses. Technical terminology is avoided, and for the most part it is not assumed that any of the students have had any previous training in the topic. Every effort is made to present the material in a concise, informal manner, thus making the concepts easy to grasp. A listing, with a description of the short courses follows. Each short course may not be offered every camp.

Animal Tracking - During this session the woods are searched for animal signs. It is possible to find the tracks of 58 different mammals here. Tracking techniques are taught. Preservation of tracks by making casts and molds is demonstrated. Emphasis is placed upon increasing the participants' ability to observe and "read" signs.

Astronomy - Each participant has the opportunity to examine the spring sky by viewing photographs as well as by using the telescope. Constellations and celestial movements are discussed. Techniques of orientation by using the stars are taught. Students have the opportunity to construct a star map.

Bird Study - This is an experience for the beginning bird student. Emphasis is placed on identification using both visual and call characteristics. Students are encouraged to keep a bird list, and to be familiar with the birds found in the camp area.

Butterflies - The material presented in this workshop is a useful guide for the identification of local butterflies as well as for the identification of plants that provide a source for their food. The ecology and special adaptations of these insects are covered. Students are taught methods of identification.

Canoeing - This session is an introduction to still-water canoeing. Safety techniques, stream dynamics, and control will be taught. Each participant is expected to demonstrate proper use of the canoe. The ability to swim is required.

Carnivorous Plants - Local pitcher plant localities are visited. The ecology and distribution are discussed. The insects that serve as food for these plants are studied. Special adaptations and other ecological requirements that have made this plant an endangered species are reviewed. Each student is expected to learn those characteristics that make a species a "good candidate" for extinction.

Caves - Trips are made into nearby commercial caves to study formation and structure. The relationship of surface topography to cave networks is examined. Those species of animals that utilize caves are discussed. Each student is taught mapping techniques of cave structure.

Edible and Medicinal Plants - The identification, procurement, and preparation of those plants that can be used for human food and medicine are taught. Each student is encouraged to make a collection and to compile a list of local plants with a description of their useful properties.

Entomology - This project is an introduction to insects with emphasis being placed on collecting techniques. Ecology, evolution, and distribution is stressed. Each student will have the opportunity to make a limited collection of common, local insects.

Ferns - Hikes are made along moist, steep slopes in search of mountain ferns. Emphasis is placed upon the role of ferns in their environment and on their identification. Reproduction and propagation are discussed. Each participant collects selected specimens of the more common ferns to learn preparation and mounting techniques.

Flyfishing - This workshop is an introduction to tackle, techniques, and lures with emphasis placed on the biology of fish, aquatic macro-invertebrate larvae and other forms of fish food. Food habits of fish are studied. Students are asked to determine the prevalent food for fish species along the length of a stream.

Geology - An introductory exposure to the geology of northeastern Alabama is accomplished through field trips in the area. Local strata, fossils,

and their interpretations are discussed. Each student completes a mapping exercise.

Herpetology - Field trips are made to find amphibians and reptiles common to the mountainous region. On the spot discussions involve the ecology, identification, and distribution of native herps. Students learn taxonomic characteristics and compile a list of amphibians and reptiles that may be expected in the region.

Limnology - The life of a stream is examined. Identification and ecology of aquatic plants and animals are discussed. Emphasis is placed on both microscopic and macroscopic life in the ecosystem. Students are introduced to a typical food chain for a given area of the stream.

Lower Plants - This is an intense study of the mosses, liverworts, and algae that inhabit the higher elevations of northeast Alabama. Special adaptations are discussed. Students are taught to identify in hand many of the species encountered.

Mountain Crafts - The craft of basket weaving and other mountain art forms are taught. Emphasis is placed upon the socio-economic aspects of "hand goods." Identification of trees and the preparation of wood materials from these trees used in basketry are discussed. Each student will make a basket or other handmade object.

Mushrooms - This is a field experience that involves a search for mushrooms that are common to the Alabama mountains. Identification and ecology are stressed. The difference between edible and non-edible species are taught. Students are instructed how to make a collection of selected species.

Oral History - Techniques of recording and interpreting mountain history are taught. Interviews with local residents are planned. Each student is instructed on how to record and produce an oral history.

Orienteering - Mapping, map reading, and compass techniques are taught. Each student completes a mapping exercise.

Ornithology - This workshop is an advanced study of birds with emphasis on evolution, adaptation, and ecology of both resident and migratory species. The student is expected to be able to identify local birds, and to relate their ecological requirements.

Photography - The techniques of nature photography are demonstrated. Subject matter, composition, lighting, etc. are critiqued. Students are asked to judge the merits of selected nature slides.

Riparian Biology - "River bank" biology, or the life associated with a local watershed, is closely examined. The class takes a short canoe trip up one of the local streams to study aquatic ecology. Students are expected to become familiar with dominant species of the ecosystem. A knowledge of canoeing and ability to swim is required.

Teacher/Youth Conservation Education - The methodology and techniques useful in conservation education in the classroom is stressed. Basic principles of plant and animal identification and ecology are used to construct nature games. Students design a functional nature game that can be used in a classroom situation. This project is structured for those teachers who wish to become skilled in teaching conservation education.

Trees and Shrubs - This workshop is an introduction to the identification of native north Alabama trees and shrubs. Emphasis is placed upon economic uses as well as ecology. Each student is taught how to make a plant collection and how to identify native species.

Wild Flowers - This is an experience involving the identification and ecology of mountain wildflowers that bloom during the spring. Students are expected to be able to identify in hand those plants encountered, and to relate these species to ecological conditions.

Long range goals for the mountain ecology workshop include:
1) the development of a nature study program for elementary and high school students and teachers;
2) the development of an educational program for undergraduate and graduate students interested in conservation education; and
3) the compilation of inventory lists for the local fauna and flora of northeast Alabama.

Increased demands on Alabama's natural resources by expanding population centers in north Alabama have underscored the importance of conservation education. This mountain ecology workshop is an attempt to help man understand his place in the environment.

REAGAN'S NEW FEDERALISM: NIXON REVISITED?[0]

Barbara M. Giles
Department of Political Science
Auburn University
Auburn University, Alabama   36849
and
Don E. Hayhurst
Department of Political Science
Auburn University
Auburn University, Alabama   36849

INTRODUCTION

The philosophy "that government is best which governs least" was pushed from center stage in the United States by the Great Depression and Great War. In its place appeared positive government with a new philosophy and role. Increasingly, there developed a pooling of resources by all three levels of government to meet changing needs of the country.

This paper presents a brief analysis of federalism during the administration of two Republican Presidents. Both Richard Nixon and Ronald Reagan have championed the traditional philosophy which supported smaller national and decentralized government. Ironically, they both labelled their efforts to return power and responsibilities to states and local governments "New Federalism". Their goals and methods for shifting government from Washington to the states, to localities, and closer to citizens are largely identical. Whereas Nixon's efforts failed, can Reagan succeed? The question is a focus of this paper.

While a few grant-in-aid programs were introduced following passage of the Sixteenth Amendment to the United States Constitution, this form of financial assistance did not become a significant factor in governmental expenditures until after World War II. In 1950 the federal government spent $2 billion on various grant-in-aid programs, but by 1960 that amount had more than tripled and approximately 132 categorical programs then cost the federal government more than $7 billion annually[1] with almost all of the money going directly to states. While number and cost of such programs continued to increase throughout the following decade, in the mid-1960's there occurred an "explosion" of categorical grants produced by Great Society programs of the Johnson Administration. As part of a broader program labeled Creative Federalism, 240 categorical grants were enacted in a five-year period (1964-1969). Much of the money was channeled to local governments directly, thus modifying the traditional constitutional basis of having the federal government deal directly with state governments and leaving local governments subordinate to the states.

The decade of the 1960's ended with the expansion of intergovernmental fiscal relations. In the early 1960's the federal system was still characterized by a strong national/state relationship with almost all federal money being channeled to states. However, by the end of the decade an increasing amount of money being spent by the federal government to support additional grant programs was targeted specifically for local gov-

ernments. This enabled the federal government to establish a direct link with local governments, thus bypassing states. Power was concentrated in Washington. The federal government could thus influence both state and local governments through use of categorical grants.

NIXON'S ATTEMPTED REDIRECTION

In 1968 Richard M. Nixon was elected President. Addressing his concerns in a program called "New Federalism", he urged restoring greater dependence on state and local government in the decision-making process to accomplish domestic goals. In his 1969 State of the Union Message, he stated,

> *The time has come to assess and reform all our institutions of government at the federal, state and local level. It is time for a new federalism in which after 190 years of power flowing from the people and local and state governments to Washington, it will begin to flow from Washington back to the states and people.*[2]

Two forms of financial assistance, block grants and general revenue sharing (in addition to categorical grants) were advocated during early years of the Nixon Administration. Both block grants and general revenue sharing were in keeping with goals of his new federalism. Block grants are defined as programs

> *. . . in which funds are provided chiefly to general purpose governmental units in accordance with a statutory formula for use in broad functional areas largely at the recipients discretion. Fiscal reporting, planning and other federally imposed requirements (such as eligibility) are kept to a minimum.*[3]

Nixon proposed to combine 129 categorical programs into six separate grants covering areas of education, law enforcement, manpower training, rural community development, urban community development and transportation.[4] Congress, however, viewed Nixon's proposals as "unrealistically extreme programs of decentralization"[5] and simply enacted watered down legislation into two block grants, Comprehensive Employment Training Act 1973 and Community Development Block Grant 1974. In 1974 Title XX of the Social Security Act was passed bringing to three the total number of block grants passed during the Nixon Administration (and to seven the total number of block grants ever passed prior to the Reagan Administration).[6]

Despite their potential for returning power to state and local governments by providing more discretion in fiscal matters, block grants were not used extensively during the 1970's. While only seven major block grants were enacted, once established they were not heavily supported. For example, the Partnership for Health program enacted in 1966 was subsequently surrounded with numerous categorical programs.[7] The Community Development Block Grant (CDBG) met a similar fate when a major new categorical program, the Urban Development Action Grant, was established separately. Moreover, block grants represented a small percentage of total federal aid given to state and local governments, averaging only about 10 percent in recent years.

Of greater potential significance for returning power to state and local governments was introduction of general revenue sharing, provided for by Congress with passage of the State and Local Fiscal Assistance Act on October 13, 1972. A $55 billion appropriation was used to fund the program from January 1973 until September 1980.[8] One-third of the money went to state governments while two-thirds went to local governments directly, thus bypassing state legislatures. When first enacted, the program had virtually no strings attached and was theoretically alleged to give state and local governments the greatest degree of discretion in use of federal assistance.[9] However, Deil S. Wright observes,

> *Indeed, starting with the 1972 enactment, it was estimated that GRS brought federal aid for the first time to over 25,000 local units. There is a grand irony in GRS as a 'New Federalism' decentralization strategy. GRS brought more local officials, especially those in small jurisdictions, into direct contact with the national government (the U.S. Treasury) than perhaps any earlier piece of legislation.*[10]

Whether revenue sharing in fact returned power to state and local governments as theoretically alleged, or whether it continued the trend of centralization as contended by Wright, this form of financial assistance constituted so small a percentage of total federal money allocated to state and local governments as to have little significant impact on any change in distribution of power within the intergovernmental structure. The Table demonstrates amounts of total grants provided in each of the three types of grants and their percentage of total grant outlays. General purpose, or general revenue sharing grants, averaged approximately $6 billion, 1972-1982, and reached 12 percent of total grants only in 1976. Broadbased or block grants averaged approximately $7.7 billion, 1972-1982, and reached 13 percent of total grants only in 1982. Other grants, or categorical grants for specific programs, consistently dominated the grant system and never fell as low as 77 percent of total grants. Thus, Washington provided ever more money except for the decline between 1980 and 1982 under the Reagan Administration (see Table 1). The budget for fiscal year 1984 reported a reduction in 190 categorical grants by either inclusion in block grants in 1981, or by consolidation or elimination.

While rhetoric accompanying introduction of block grants and revenue sharing purported to decentralize power in Washington and return authority to state and local governments (whether or not in fact they did), categorical grants which remained the primary source of federal financial assistance were simultaneously accompanied by a dramatic growth in mandates. David R. Beam writes, "While there was an effort to reduce federal leverage as exercised through the 'carrot' of narrow purpose categorical grants, there was a substantial increase in use of the tougher and more intrusive regulatory 'stick'".[11] Prior to 1960 it is estimated that the federal government imposed only 14 mandates, while by 1970 that number had increased to 178. This trend continued during the 1970's so that today the number of mandates imposed by the federal government on state and local governments is estimated to be 1,259. Most of the mandates (1,036) established conditions of aid while the remaining 223 were direct orders; of these mandates 59 established cross-cutting regulations relating to such matters as civil rights and environmental protection and applied to most federal grants regardless of their specific purpose.[12]

Table 1. Outlays for general-purpose, broad-based, and other grants (dollar amounts in millions).

	Actual					Estimate		
	1972	1976	1980	1982	1983	1984	1985	1986
General-purpose grants:								
General revenue sharing		$6,243	$6,829	$4,569	$4,567	$4,567	$4,567	$4,567
Other general purpose fiscal assistance and TVA[1]	$516	907	1,765	1,941	1,878	2,501	2,475	2,708
Subtotal, general-purpose grants	516	7,150	8,594	6,510	6,445	7,608	7,042	7,275
Broad-based:								
Community development		983	3,902	3,792	3,525	3,526	3,474	3,497
Health	90	128	83	661	1,115	1,299	1,357	1,357
State education block grants				48	35	440	451	451
School aid in federally affected areas	602	558	622	546	572	499	478	468
Employment and training		1,698	2,144	1,793	1,639	1,415	1,886	1,886
Social Services	1,930	2,251	2,763	2,567	2,571	2,500	2,600	2,700
Low-income home energy assistance				1,685	1,961	1,396	1,349	1,298
Other	233	554	818	390	414	476	689	972
Subtotal, broad-based grants	2,855	6,172	10,332	11,482	11,832	11,551	12,284	12,629
Other grants	31,001	45,771	72,546	70,202	75,260	77,307	79,836	82,564
Total	34,372	59,093	91,472	88,194	95,537	95,926	99,162	102,468
ADDENDUM: PERCENT OF TOTAL								
General-purpose grants	1.5%	12.1%	9.4%	7.4%	6.9%	7.4%	7.1%	7.1%
Broad-based grants	8.3%	10.4%	11.3%	13.0%	12.6%	12.0%	12.4%	12.3%
Other grants	90.2%	77.5%	79.3%	79.6%	80.5%	80.6%	80.5%	80.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[1]Includes shared revenues from the Tennessee Valley Authority.

Source: *Special Analysis, Budget of the United States Government, Fiscal Year 1984*, Executive Office of the President, Office of Management and Budget, p. 255.

Overall, federal mandates and regulations have been the target of a great deal of criticism. David R. Beam reveals,

Although particular problems vary from program to program, critics have leveled at least seven frequent charges against federal inter-governmental regulations singly and as a whole. The new mandates, they believe, are too often expensive, inflexible, inefficient, inconsistent, intrusive, ineffective and unaccountable.[13]

Specifically, however, federal mandates deny states discretion in administration of intergovernmental programs. David B. Walker states,

The vertical specific program-related condition and mandates after all indicate a stronger federal adherence to the nation 'super-inten-dency' theory of intergovernmental administration . . . and a concom-itant rejection of the states' role as a planner, coordinator and supervisor of big intergovernmental grants. Many of the horizontal federal mandates reflect a distrust of, if not contempt for, state administration and processes . . . .[14]

Thus, if intergovernmental finances are an accurate yardstick, while President Nixon talked about reversing the trend of centralization which had characterized intergovernmental relations since the 1930's, his ac-complishments were minimal at best. In theory block grants and revenue sharing purported to allow state and local governments greater discretion than had categorical grants. While there remains some question whether in fact state and local governments acquired more power through these forms of financial assistance, the question is insignificant because neither form constituted a large percentage of total federal assistance. On the other hand, the addition of federal mandates which accompanied categorical grants probably neutralized any real reversal of centralization from tak-ing place.

Despite attempts of Nixon's Administration to establish a New Feder-alism, his overall lack of progress in effecting change would force future administrations to reiterate the same goals, address the same problems, and attempt to meet the same challenges.

REAGAN'S ATTEMPTED REDIRECTION

The first year of his term, President Reagan sought to accomplish several objectives. Two of the more important objectives, which have a major import for intergovernmental relations, included reduction in fed-eral spending along with a reduction in administrative regulations, and reform of the federal system in such a manner as to return power to the states.

With a reduction in federal spending being his first order of busi-ness, President Reagan, on February 18, 1981, asked Congress to cut $41.1 billion from FY 1982 spending requests (which had been submitted by Car-ter). To accomplish this goal, Reagan, with encouragement from OMB Direc-tor David Stockman, proposed using reconciliation measures for consolidat-ing budget cuts into a single package, as provided for by the Congression-al Budget and Impoundment Control Act of 1974.[15] When officially submit-

ted to Congress on March 10, President Reagan's package called for $48.6 billion in savings.

While receiving less opposition in the Republican-controlled Senate, the controversial budget reconciliation proposal managed to pass in the Democratic-controlled House as well. House action was described as "a stunning triumph for President Reagan."[16] After some debate in both chambers, President Reagan signed the bill into law on August 13, 1981. The bill, which was expected to cut FY 1982 spending by $35.2 billion, was described as the "deepest and most widespread package of budget cuts in the history of Congress affecting hundreds of federal programs."[17]

In keeping with goals of the Reconcilation Bill to cut federal spending, overall grant outlays to state and local governments were cut to $88.2 billion in FY 1982; that was approximately a 12 percent reduction in the $99.8 billion called for in the Carter budget. Included as part of the Reconciliation Bill was a proposal to allocate a larger than ever portion of the money to state and local governments through use of block grants.[18] Such block grants would serve a two-fold purpose of the Reagan Administration: 1) to compensate for the cut in federal spending by providing more services for less money because of alleged administrative efficiencies, and 2) to return power to state and local governments.

At first, President Reagan recommended consolidating 130 existing categorical programs into 15 new block grants and eliminating 95 other categorical programs. In submitting specific legislation to Congress, however, he called for consolidating 84 categorical programs into six block grants costing $11 billion. Simultaneously he called for a 25% cut in the level of funding for each consolidated program. To compensate states for the funding cuts, block grants would allow states more leeway in how money was spent, which in turn could result in administrative efficiencies. As reported in *Congressional Quarterly*, "Lumping the programs together would result in efficiencies that would help offset the proposed reductions in funding that accompanies block proposals."[19]

In calling for reduction in federal spending, President Reagan simultaneously called for reduction in regulations accompanying federal programs. In justifying these two mutually reinforcing goals, Edwin L. Harper, the OMB Deputy Director, explained that, "In order for the state to insure that these reductions (fiscal) could occur without causing a reduction in service levels, we quickly realized that massive reductions in program prescriptiveness and administrative requirements had to accompany budget cuts."[20] To insure that the issue of regulatory relief was given appropriate consideration President Reagan, two days after taking office, created a Task Force on Regulatory Relief. Headed by Vice President George Bush, the Task Force was charged with "receiving pending regulations, studying past regulations with an eye toward revising them and recommending appropriate legislative remedies."[21] The matter was further addressed by means of Executive order 12291, issued February 17, 1981. In part the order provided that, "Regulatory action shall not be undertaken unless potential benefits to society from regulations outweigh costs to society . . . Among alternative approaches to any given regulatory objective the alternative involving the least net cost to society shall be chosen."[22]

A second major objective of President Reagan was to return power to state governments. David W. Moran, Director of OMB for Human Resources

said, "For too long they (the states) have been excluded and bypassed. The president intends to restore to them their rightful constitutional authority and responsibility in the federal system."[23] David A. Stockman stated, "We are overloaded at the national level. We simply cannot make decisions on the thousands of issues that come before us. There has to be a better division of labor and deregulation of decision making at the lower levels of government."[24]

On April 8, 1981, President Reagan announced formation of the Presidential Federalism Advisory Committee. The committee, headed by Senator Paul Laxalt,[25] was charged with three major tasks: 1) informing the President about the impact of federal policies on state and local governments, 2) advising him on implementation of his new federalism proposals, and 3) establishing long-term policies in order to decentralize power in Washington.[26]

Congress, too, appeared supportive of this goal by providing for establishment of a Commission on More Effective Government. While one responsibility of the Commission was to recommend ways for the federal government to become more efficient, the Commission was also given the task of studying and recommending changes to improve the relationship among all three levels of government.

In practice, the objective of returning power to states could be served by use of block grants, which gives states a great deal of discretion in how money is spent. Conditions the Reagan administration attached to block grant proposals were so lenient that they have often been described as resembling more closely the special revenue sharing programs (first advocated by the Nixon Administration) rather than existing block grant programs.[27] On this matter *Congressional Quarterly* reports,

> *President Reagan has proposed transferring power from the federal government back to the states, chiefly through block grants that would enable them to use certain funds as they--not Washington--see fit . . . . Under Reagan's new federalism the states will have more flexibility in spending allocated federal dollars.*[28]

Congress, however, responded to these recommendations by severely altering the Administration's proposals for block grants. For the most part, Congress agreed to the recommended 25% cut as well as the functional areas to be handled by these programs (education, health and social services). However, Congress altered the number of block grants sought as well as the number of programs to be consolidated into the block grants that were enacted. In all, nine block grants were enacted, consolidating 77 grants.[29] Another change in the Administration's proposals occurred when Congress did not concur with the recommended lenient requirements. Instead, Congress enacted additional restrictions and requirements as part of the block grant programs. For example, a common restriction accompanying most newly enacted block grants was that every state must hold public hearings and then issue public notice about plans for how federal money would be spent.[30] The result of Congressional action was a "scaled-down" version of the Reagan proposals. However, it may be viewed as a first step in attaining a long-range goal--the return of power from Washington to the states.

As Reagan embarked on the second year of his term he appeared even more committed to this goal. In his State of the Union message delivered to Congress on January 26, 1982, Reagan called for a New Federalism. For the immediate future he proposed that in FY 1984 the federal government would assume the cost of Medicaid, the health care program for the poor and one of the fastest growing entitlement programs; in exchange, the states would take over food stamp programs and Aid to Families with Dependent Children (AFDC),[31] a switch that would begin in October 1983 and take eight years to complete.

A second and more long-term objective of Reagan's New Federalism is transfer to the states of more than 40 federal programs in service areas traditionally reserved for states (education, community development, transportation, etc.). He proposed that the transfer would be voluntary through FY 1987 but mandatory thereafter. Along with the AFDC and food stamp program, these programs are estimated to cost $47 billion. The cost of Medicaid is estimated at $19 billion. The $28 billion a year difference would be supported by a trust fund to be financed by federal excise taxes on gasoline, liquor, tobacco; and oil windfall profits would by made available to them.[32] However, the trust fund was to be temporary, and beginning in FY 1988 it would be phased out by a $7 billion a year reduction. Thus by FY 1991 states would by completely on their own and would be forced to make some hard decisions about maintenance of the programs. They could either increase their own excise taxes (to replace ones which Reagan promises will be repealed) or simply discontinue programs. President Reagan defended his proposals by stating, "In a single stroke we will be accomplishing a realignment that will end cumbersome administration and spiraling costs at the federal level while we insure these programs will be more responsible to the people they are meant to help and the people who pay for them."[33] Decisions on taxes would thus be decentralized.

Reaction to Reagan's proposal was mixed. Most support came from Republicans in Congress, but many Democrats perceived the President's proposal as an attempt to dismantle many social programs started during the New Deal Era. At the state level most support came from Republican governors while Democratic governors, particularly those whose states would lose dollars in the swap, objected to the President's program.[34] Most state officials are aware that enactment of Reagan's proposals will present a dilemma: state officials will have to decide whether to financially support and continue many social programs now in existence (which will undoubtedly necessitate an increase in state taxes) or simply discontinue them. Whatever their decision, state officials will please some and offend others. Reaction from local officials was for the most part understandably negative. Most people benefiting from programs which might eventually have to be discontinued are urban residents. In addition, local officials would find themselves dealing more directly with state governments which they have come to distrust.

Support for Reagan's New Federalism proposals from all three levels of government remains less than overwhelming. Thus, the question persists, "What are Reagan's chances for achieving a New Federalism?" Are conditions in the 1980's sufficiently different from those of Nixon's Administration to offer a prospect for real change?

REAGAN AND NIXON EFFORTS COMPARED

Both Reagan and Nixon labeled their programs for bringing about changes in the federal system "New Federalism". Yet, despite this similarity many differences distinguish one from the other, thus offering some prospect that change in the federal system may occur.

It should be noted that Reagan is concerned foremost with domestic affairs, whereas Nixon was primarily concerned with foreign affairs and extrication of the United States from Vietnam. Both the mood and needs of the country were changed.

Another major difference is the composition of Congress. President Nixon was forced to work with a Democratic-controlled House and Senate, whereas President Reagan's victory in 1980 was accompanied by significant changes in Congress. Republicans made enough gains in the Senate to establish themselves as the majority party. They hoped to use this advantage to influence House votes as well. As House Republican leader Robert Michels of Illinois stated on February 19, 1981, "House Republicans would try to use the expected accomplishments of the GOP Senate to generate public pressure for similar action by the House Democratic leadership."[35] In addition to dramatic change in the Senate, significant increases were made in the House as well. Commenting on change in the House, Michels again stated, "In the election we made a significant dent into that number of Democrats who are considered to be liberals and replaced them with conservatives on our side. But we still have to get 25 to 30 conservatives from the Democratic side."[36]

Results of the 1980 election provided an apparent mandate for Congress to change significantly its course of action and to cut domestic federal spending. Democrats, unable to ignore the election message, found themselves in a particularly tenuous situation. If they succeeded in defeating the President's programs, Republicans would undoubtedly blame them for the failure in the 1982 election campaign. If they helped to pass the President's proposals, they would have no accomplishments of their own to claim in the 1982 election. While Southern Democrats (bollweevils) voted with Republicans to pass many of the President's proposals, the Northern Democrats, knowing that they had little chance of success in opposing them, simply offered amendments as a means of establishing their objections.[37]

Republicans zeroed in on the Democrats' dilemma and made a concerted effort to court their votes. The result was the strongest coalition between Republicans and Southern Democrats in 25 years. As reported in *Congressional Quarterly,*

The conservative coalition of Republicans and Southern Democrats—the backbone of President Reagan's support in both House and Senate during the 97th Congress—in 1981 showed a strength unequaled in the 25 years CQ has measured the coalition's muscle.

Overall, the voting alliance of Republicans and Southern Democrats outpolled Northern Democrats on 92% of the recorded votes in both houses in which the two groups faced off.[38]

The 92% score is most impressive when compared to previous scores, partic-

ularly those of Nixon. During the Nixon Administration the coalition's success rate waivered between a high of 83% in 1971 and a low of 59% in 1974.

Success of the coalition between Republicans and Southern Democrats in the 97th Congress in passing many of Reagan's proposals or defeating those he objected to resulted in a high score for the President when congressional votes are matched with the President's announced position. While receiving a higher score in the Senate (87.5%) than in the House (72.4%), his overall score was 81.9%. *Congressional Quarterly* reports that "not since the administration of Lyndon B. Johnson (who scored 93% in 1965) has the *CQ* study registered such harmony."[39] By means of contrast the lowest score (50.6%) ever recorded since *Congressional Quarterly* began this study in 1953 was achieved by Richard M. Nixon in the midst of the Watergate era in 1973. While several precautions must by taken in interpreting this study,[40] what was even more impressive was the extreme loyalty shown by Senate Republicans. *Congressional Quarterly* reports that "no other president has commanded such loyalty from members of his own party in either house since *CQ* made its study 29 years ago."[41] Although it is typical for presidents to score better in the first year of their term, President Nixon never started out as high as Reagan did. Nixon began with a score of 74% in 1969 and increased to 77% in 1970; thereafter his score declined steadily to 75% in 1971, 66% in 1972, 50.6% in 1973 and 59.6% in 1974.[42]

President Reagan considered modifying his original plan to make it acceptable to state governors. There was early speculation regarding specifics, but some were predicting Reagan would agree to federal takeover of Medicaid without requiring states to assume the food stamp and welfare programs. Instead, transportation, education and job programs might be substituted for the entitlement programs.[43] This may have been a clever strategy by the President to obtain bargaining power and get states to cooperate with him.

In addition to differences in the composition of Congress and in their relationships to Congress, specifics of their proposals also distinguish the two presidents from each other. While both Nixon and Reagan wanted to return power to the states, the means by which this goal was to be accomplished differed. Nixon advocated use of block grants and revenue sharing, both of which he was only partially successful in selling to Congress. However, Reagan, while successfully recommending an increased use of block grants, proposed taking the "New Federalism" a step further as outlined in his State of the Union message on January 26, 1982. This appears to be a logical step in light of political and structural changes that had occurred at the state level since the administration of Nixon.

The states have undergone major structural changes during the last 20 years which should better equip them to assume additional responsibility and power within the federal system. The executive branches have been strengthened by changes in the tenure arrangement. In 1980, 46 governors were permitted to serve four-year terms; of these, 45 were able to succeed themselves. In addition, the executive branch of state government has been strengthened by making the governor the focal point of the budget process in 47 states. The legislative branch has undergone similar changes. The legislature in 36 states is now permitted to meet annually. Reapportionment has taken place in all 50 states. And reorganization of

the committee structure and addition of professional staff in reference and legal services have also strengthened legislative branches of state government.

Another important development which should also better equip state and local governments to assume more power and authority within the federal system is growth in number of state and local employees. According to Charles Schultze, ". . . the federal government uses state and local governments . . . as 'subcontractors' to produce centrally determined a- mounts and kinds of collective goods . . . ."[44] While the number of state and local employees has increased dramatically since 1960, the number of federal employees has remained constant. Thus, a positive byproduct of the categorical grant system has been establishment of machinery to imple- ment additional power and responsibilities which states may acquire should Reagan's proposal for a New Federalism succeed.

The lack of adequate state and local fiscal resources, however, off- set improved structural changes that have been made and present real pro- blems with which the states will have to cope. The financial situation of the late 1970's which resulted in tax revolts and spending limitations has changed. A survey by *The New York Times* revealed that more than half of the states have had to increase taxes and fees, not to provide additional services, but simply to support those already in existence.[45] If state governments find it necessary to increase taxes, now would be an appropri- ate time. While the federal government has shed some responsibilities (by means of FY 1982 budget cuts), it must be remembered that simultaneous tax cuts were made at the federal level as well. Although states may choose to take up the slack in federal programs which are being cut, they may give serious consideration to another alternative--a cutback in govern- mental services in the state. As Michael Mitchell states,

> . . . For many Americans (the future) will mean a decreased standard of living, including fewer government services and benefits. Such sacrifice, however, appears to be essential for the economic recovery that will stabilize many other aspects of our national life. The es- sence of leadership in this period of austerity will be to encourage the acceptance on the part of the American people of this decreased living standard, including reduced governmental programs, to achieve the desired economic recovery. In other words, we must live with short-term pain in return for long-term gain. This is the message that began to be transmitted in 1980. Its reaffirmation will be a fundamental task of public officials at all levels of government in the coming years.[46]

The federal government, particularly through the Reagan proposals, responded to the mandate of the 1980 election by cutting governmental services and taxes to support them simultaneously. The federal government took the lead in establishing a trend which states may follow. The stage was set for states to play an enlarged role in the federal system. How- ever, the 1982 election brought Reagan's honeymoon with the 97th Congress to an end. Although Republicans retained control of the Senate, Democrats gained 26 seats in the House, increasing their majority to 268 in the 98th Congress. Bipartisan support held for "Social Security rescue" and a "Jobs Bill" to deal with the recession, but bollweevil support for Reagan

had slipped. While defections to support Reagan programs had provided his victories in 1981 and 1982, only 36 House Democrats voted against the so-called "budget blueprint" of the Democratic leadership in 1983. Although the House Republican leader called the budget blueprint "nothing more than a statement of political principle and a framework for the Democratic National Convention platform in 1984", slippage of Reagan's bollweevil support signaled trouble and delay for new federalism proposals. Higher priority for presidential election politics and the struggle for partisan advantage in dealing with domestic programs and national defense may cause new federalism to wait yet another day.

CONCLUSIONS

Whereas Nixon's support in 1972--even before Watergate--was partially tainted as the lesser of evils, Ronald Reagan's strength in 1984 was more positive. Whereas the federal budget more than doubled from 1961 to 1971, from 1971 to 1981 it more than tripled. And whereas grants from Washington to state and local governments more than tripled during the decade of the 1960's, they more than tripled again during the decade of the 1970's. Total spending, grants to state and local governments, and growth in regulations from Washington appeared out of control by 1980.

The 1980 presidential election is history. The country was clearly more conservative than a decade earlier. Republicans surprisingly captured control of the U.S. Senate and increased their strength in the House. Moreover, conservative Democrats from the South joined in coalition with Republicans to an extent unequaled before. Then came the mid-term election in 1982.

State and local governmental structures and processes presently are much improved over those of a decade earlier. State and local bureaucracies are also much larger and strengthened, as Congress has kept employment in the federal government stable by the political expedient of consistently assigning new programs to states and local governments to carry out. Thus state and local governments have grown under the impetus from Washington.

Compromise is the essence of politics. Richard Nixon largely failed in his efforts to create a "new federalism" by returning responsibilities and authority to state and local governments, just as he also failed to achieve acceptance of a Family Assistance Plan (FAP) to deal with welfare problems. However, he succeeded in establishing General Revenue Sharing (GRS) which was an innovation in intergovernmental finance. Money is returned to state and local governments to spend at their own discretion rather than Washington's. However, Congress has never provided more than a very small portion of total grants in this unrestricted form, averaging approximately 8 percent 1972 to 1982.

Ronald Reagan's proposal for a "new federalism" is comprehensive. It would return responsibilities and authority by a reassignment of functions and services, along with decision-making authority among governments. Furthermore, he would provide a greater portion of grants from Washington with fewer strings attached.

Compromise is likely. Hundreds of categorical grants from Washington for specific programs will die hard, if at all. Pet programs of powerful Congressmen must receive accommodation by political negotiation. Constit-

uent groups know from experience it is easier to lobby one government than 51 or more. However, many specific programs will likely die. While the exact outcome is not certain, spending must be brought under better control within the federal system. Through compromise functions and services must be sorted out and reassigned in a manner which will assure maximum capacity to perform them, if they are to be performed at all. Issues which Reagan's new federalism seeks to address were long in building. Logically, in a political system characterized by compromise, issues will not be reversed or resolved in the span of four years. Beyond the 1982 election, political attention focuses most sharply on 1984. If the world is to be made safe for reelection, new federalism can wait. Bread and butter priorities prevail whenever political survival is at stake. While Reagan enjoyed many successes in 1981 and 1982, only one of the 10 new or revised block grants he proposed in 1982 for FY 1983 was passed. Following mid-term losses in 1982, fate of his new federalism was more in doubt. No "Reagan Revolution in Fiscal Federalism" had occurred. But, will politics-as-usual be able to deal new federalism a knockout blow? Is Reagan's "New Federalism" Nixon's revisited?

The present researchers conclude Reagan's version of new federalism has a greater chance of success than Nixon'a a decade ago. A more conservative political constituency, and consequent alignment of political forces focusing more on domestic issues, different from the Nixon era, will likely result in some success for the President. Should Reagan be elected to a second term in 1984, the future of his new federalism should improve still more.

FOOTNOTES

[1]Only four (of the 132) programs accounted for 75 percent of the total grant outlays; highways, aid to the aged, aid to dependent children and employment security (in order of dollars spent). Advisory Commission on Intergovernmental Relations, *The Federal Role in the Federal System: The Dynamics of Growth, An Agenda for American Federalism: Restoring Confidence and Competence*, (Washington, D.C.: June 1981), p.2.

[2]Quoted in *Newsletter*, a joint service of the National Association of Counties and the National League of Cities, No. 34 (Washington, D.C.: January 27, 1969), p.1.

[3]Advisory Commission on Intergovernmental Relations, "Block Grants: The Promise and Reality," *Intergovernmental Perspective*, Spring 1981, Vol. 7, No. 2, p. 16.

[4]Claude E. Barfield, *Rethinking Federalism*, (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1981), p.3.

[5]Timothy J. Conlan, "Back in Vogue: The Politics of Block Grant Legislation", *Intergovernmental Perspective*, Spring 1981, Vol. 7, No. 2, p. 11.

[6]This includes broad-based grants to aid schools in federally affected areas as well as those pertaining to local public works.

[7]Conlan, *op. cit.*, p. 12.

[8]In December 1980, Congress renewed the revenue sharing program. For FY 1981 $4.6 billion, the same as in past years, was appropriated to the local governments only, with no appropriation being made for state governments. For FY 1982 and 1983 funding for local governments would remain

constant while Congress authorized $2.3 million for states. However, states must return an equal amount of categorical grant funds.

[9]In 1976 the Act was amended to include, among other things, some citizen participation requirements, more comprehensive financial reporting and publicity mandates and greatly strengthened nondiscrimination provisions. In analyzing the impact of the 1976 alterations on the intergovernmental structure, Deil S. Wright states, "The nondiscrimination provision reflected congressional intent to expand national level oversight and control over state/local uses of GRS monies." Wright, *op. cit.*, p. 128.

On the other hand, Michael C. Mitchell, referring to the 1976 changes observes, ". . . it still allows greater flexibility to state and local officials than any other federal program. As such it represents an important symbol of state and local autonomy and identity in the intergovernmental system." "Washington Grapples with the Budget Crunch," *Intergovernmental Perspective*, Winter 1981, Vol. 7, No. 1, p. 10.

[10]Wright, *op. cit.*, p. 129.

[11]David R. Beam, "Washington's Regulation of States and Localities: Origin and Issues," *Intergovernmental Perspective*, Summer 1981, Vol. 7, No. 3, p. 8.

[12]Barfield, *op. cit.*, p. 21. ACIR, *A Crisis in Confidence and Competence*, p. 447; Catherine H. Lovell and Others, *Federal and State Mandating on Local Governments: An Exploration of Issues and Impacts*, A Report to the National Science Foundation (Riverside, Calif.: University of California, 1979). William E. Hudson, "The New Federalism Paradox," *Policy Studies Journal* (Summer 1980), pp. 900-906.

[13]Beam, *op. cit.*, p. 13.

[14]David B. Walker, "The States and the System: Changes and Choices," *Intergovernmental Perspective*, Fall 1980, Vol. 6, No. 4, p. 12.

[15]The act was designed with the hope that members of Congress would be more willing to compromise over a package of savings rather than on individual spending cut measures. When first used in 1980 (for FY 1981), it succeeded in saving $4.6 billion in expenditures and provided $3.6 billion in new revenues. At the instruction of the House and Senate Budget Committees, the other committees are assigned with making appropriate budget cuts; their subsequent reports are filed as a single omnibus bill which is given a single vote in each chamber.

[16]"Reagan Victory May Bring House Backlash," *Congressional Quarterly*, July 4, 1981, p. 1168.

[17]"How Cuts Were Fashioned," *Congressional Quarterly*, August 15, 1981, p. 1464.

[18]Dale Tate, "New Federalism No Panacea for State, Local Governments," *Congressional Quarterly*, April 25, 1981, p. 709. Block grant proposals recommended by the Reagan Administration would account for 38% of the grant-in-aid funds to state and local governments for FY 1982; this was a significant increase over the 16.6% recommendation proposed by Carter. However, as enacted by Congress, they constitute approximately 12.6 percent for FY 1983 and 12 percent for FY 1984. (See Table above).

Block grants are traditionally supported by Republican administrations and generally opposed by Democratic ones on the basis of attempting to dismantle social programs. "Block Grants: An Old Republican Idea," *Congressional Quarterly*, March 14, 1981, p. 449.

[19]"Block Grants: An Old Republican Idea," *Congressional Quarterly*, March 14, 1981, p. 449.

[20]Barfield, *op. cit.*, p. 25. Edwin L. Harper testifying before the Senate Subcommittee on Intergovernmental Relations, May 13, 1981.

[21]Beam, *op. cit.*, p. 18.

[22]*Ibid.*, p. 18.

[23]Barfield, *op. cit.*, p. 24. Interview with Donald W. Moran, May 12, 1981.

[24]Barfield, *op. cit.*, p. 24. David A. Stockman, testimony before the House Subcommittee on Manpower and Housing, April 28, 1981.

[25]In addition to the task force which included top White House aides, five Cabinet officers and the OMB director, the committee was made up of 40 representatives from Congress, public life and state and local governments.

[26]Advisory Commission on Intergovernmental Relations, "Intergovernmental Focus," *Intergovernmental Perspective*, Spring 1981, Vol. 7, No. 2, p. 4.

[27]Barfield, *op. cit.*, p. 29.

[28]Dale Tate, "New Federalism No Panacea for State, Local Governments," *Congressional Quarterly*, April 25, 1981, p. 708.

[29]Carol S. Weissert, "1981: A Threshold Year for Federalism," *Intergovernmental Perspective*, Winter 1982, Vol. 8, No. 1, p. 4.

[30]Ann Pelham, "New Block Grant Transition From U.S. to States May Take Up to One Year," *Congressional Quarterly*, August 15, 1981, p. 1513.

[31]At the present time the federal government finances almost entirely the food stamp programs and slightly over half of AFDC. The OMB estimates that the states will have to pay $16.5 billion to operate these programs but will save $19.1 billion in Medicaid costs. However, the costs and saving would not be evenly distributed. For example, it is estimated that if Reagan's proposal had been in effect in 1981, it would have cost the State of Alabama $258.3 million while the State of California would have saved $300 million. Tom Scarritt, "Reagan Partnership Program Could be Costly to Alabama," *The Birmingham News*, January 27, 1982, p. 4A.

[32]In addition to helping states pay for these programs, the trust fund money would also be used to compensate for any losses incurred in the swap.

[33]Tom Scarritt, *op. cit.*, p. 4A. Implicit in the term single stroke is the idea that federalism would be presented to Congress as a single package (much like the Reconciliation Bill in 1981). However, Tip O'Neill was quick to inform people that these measures would be considered individually and not as a single package. "State of the Union," *Time*, February 8, 1982, p. 15.

[34]States are philosophically committed to change which will result in added responsibilities for them. However, they object to specific programs which Reagan has proposed to swap. AFDC and the food stamp programs are viewed as particularly undesirable due to abuses which accompany them. While states have been requesting to take over many road building and capital construction programs, (those less controversial than entitlement programs), they have recommended that the federal government finance and operate all income maintenance programs. "New Federalism or Feudalism," *Time*, February 8, 1982, p. 19.

[35]Irwin B. Arieff, "House GOP, Still a Minority, Seeks Peace with

Democrats; Senate Parties Reverse Roles," *Congressional Quarterly*, February 28, 1981, p. 380.

[36]*Ibid.*, p. 379. (The 97th Congress contained fewer Southern Democrats but more Republicans than the 96th Congress. In the Senate there were 68 Republicans and Southern Democrats vs. 60 in the 96th Congress; there were 270 in the House vs. 243 in the previous Congress. Irwin B. Arieff, "Conservatives Hit New High In Showdown Vote Victories," *Congressional Quarterly*, January 9, 1982, p. 50).

[37]*Ibid.*, p. 380.

[38]Irwin B. Arieff, "Conservatives Hit New High In Showdown Vote Victories," *Congressional Quarterly*, January 9, 1982, p. 50. Of the number of recorded votes from both houses, the coalition appeared on 21% of the issues.

[39]Bill Keller, "Voting Record of '81 Shows the Romance and Fidelity of Reagan Honeymoon on Hill," *Congressional Quarterly*, January 2, 1982, p. 18.

[40]*Ibid.*, p. 18. For example, the study does not include issues that were defeated before they reached the floor, rather only those that reached a roll call vote. Secondly, only issues where the President's stand was clear were counted and, thirdly, some of the votes were on non-controversial issues, but all were weighed equally. Moreover, no votes are included in the 98th Congress.

[41]*Ibid.*, p. 19.

[42]*Ibid.*, p. 18.

[43]Steven R. Weisman, "Reagan and 'New Federalism' are Ready to Go on the Road," *The New York Times*, February 7, 1982, p. 5E.

[44]Barfield, *op. cit.*, p. 9. Charles L. Schultze, "Sorting Out the Social Grant Programs; an Economist's Criteria," pp. 182-183.

[45]John Herbers, "States Failed Before on Basic Needs; They Could Again," *The New York Times*, January 31, 1982, p. 2E. According to *Intergovernmental Perspective*, Spring 1983, Vol. 9, No. 2, p. 34, employment at the national, state, and local levels declined 1980-1981 from 16,213,000 to 15,968,000. (Decline was 1.1%, 0.7%, and 1.9%.)

[46]Mitchell, *op. cit.*, p. 18.

BEHAVIORAL CHARACTERISTICS OF INFANTS OF DIABETIC MOTHERS[1]

Ellen B. Buckner, J Gail Williams,
Kathleen G. Nelson, and John F. Huddleston
School of Nursing
University of Alabama in Birmingham
Birmingham, AL 35294

INTRODUCTION

The assessment of behavioral characteristics of newborns is based on a conceptual understanding of the neonate as a highly complex individual, capable of eliciting responses from caretakers and adapting to environmental stimuli. The assessment data can be utilized to detect subtle responses to a variety of stimuli but can also be used to anticipate the effect the infant will have on its environment in the future. Thus, assessment of behavioral characteristics can be used both to identify the effects of an abnormal pregnancy state on the infant and to provide data for planning follow-up care. This study was undertaken to describe the behavioral characteristics of infants of diabetic mothers in order to detect subtle differences from "normal" infants which would assist clinicians in understanding the effects of prenatal environment and to plan optimal home environments for these infants.

METHODS

Behavioral characteristics were assessed utilizing the Brazelton Neonatal Behavioral Assessment Scale (BNBAS). The BNBAS is based on the concept that the neonate is a highly complex organism possessing adaptive mechanisms including the ability to shut out unpleasant stimuli and the ability to modulate own state of alertness to attend to attractive stimuli. The 26 item scale is scored after an interactive examination in which graded levels of irritating stimulation are given and attempts are made to elicit the infant's best performance to social stimulation. The BNBAS has been used to describe differences in newborns from different cultures, low birth weight infants, newborns of heroin addicted mothers, babies undergoing phototherapy for hyperbilirubinemia, and to predict future outcome of suspect infants. (Als, et al. 1979.) In a study by Yogman, et al. (1981) using the BNBAS, healthy infants of diabetic mothers (IDM'S) showed poorer scores on items reflecting visual and auditory orientation, motor performance, and autonomic stability.

The 26 items can be grouped into four clinical clusters or dimensions based on an *a priori* cluster technique (Als, et al. 1979). These clusters are: (1) Interactive Processes, (2) Motoric Processes, (3) Organizational Processes of State Control, and (4) Organizational Processes of Physiologic Response to Stress. Figure 1 lists behavioral items contributing to each of the dimensions. Clusters were scored according to the infant's

DIMENSION I:
    Interactive Processes
        Alertness
        Orientation
        Consolability

DIMENSION II:
    Motoric Processes
        Motor Tone
        Motor Maturity
        Activity
        Reflexes

DIMENSION III:
    Organizational Processes of State Control
        Habituation
        State Lability
        Irritability

DIMENSION IV:
    Response to Stress
        Skin color change
        Startles
        Tremulousness

Figure 1.   Behavioral Items Contributing to Each of the Clinical Cluster
        Dimensions.

performance as: 1 = Excellent, 2 = Average, or 3 = Poor. Summary scores
were calculated as the sum of cluster scores from the four dimensions with
a possible range of 5-12. A summary score of 4 was not possible since
there are only "average" and "poor" scores for dimension IV. Thus, the
higher the summary score, the poorer the infant's overall performance.
    Twenty-one infants were examined using the BNBAS in the neonatal pe-
riod. Examinations were done by the nurse-investigator who is certified
as reliable in the administration and scoring of the BNBAS. The examiner
was unaware of the mother's prenatal course at the time of the examina-
tion. All infants weighed at least 2500 grams at birth and were born to
mothers whose diabetic condition ranged from class B to F. By this clas-
sification system all mothers were receiving insulin during pregnancy.
Descriptive statistics of the sample were calculated using procedures in
the Statistical Package for the Social Sciences (SPSS, 1975).
    In order to investigate the direct relationship between infant behav-
ioral performance and maternal diabetic control in pregnancy, the summary
scores were correlated with calculated values for maternal hyperglycemia.
Data for maternal blood glucose levels were available for the third tri-
mester because mothers had kept diaries of their patterned blood sugars
(PBS) for the purpose of modifying insulin dosage. Mothers were monitor-
ing glucose levels at home using the Ames® meter and patterned blood sug-
ars (7 AM, 11 AM, 4 PM, and 9 PM) were obtained at least once a week, or
more often as needed. Control was geared toward keeping all levels at 100

mg %, and significant high or low values were called in to the physicians so that adjustments in insulin dosage could be made. Mean levels of PBS hyperglycemia were calculated for the third trimester as follows: for each patterned time, 100 mg % was subtracted from each recorded value greater than 100 mg %. This difference (excess above 100 mg %) was then multiplied by the number of days until the next glucose measure was obtained. The multiplied differences were added together and a mean calculated for the third trimester by dividing the total by the number of days constituting the third trimester for each woman. Mean blood sugar elevations were calculated for each pattern time (Figure 2). These means were then correlated with the summary scores from the behavioral assessment of the newborn.

Mean Fasting Blood Sugar = $\dfrac{\text{Total Mg \% over 100 mg \%}}{\text{Days of Data}}$
     (7 AM)

Mean 11 A.M. Blood Sugar = $\dfrac{\text{Total Mg \% over 100 mg \%}}{\text{Days of Data}}$

Mean 4:00 P.M. Blood Sugar = $\dfrac{\text{Total Mg \% over 100 mg \%}}{\text{Days of Data}}$

Mean 9:00 P.M. Blood Sugar = $\dfrac{\text{Total Mg \% over 100 mg \%}}{\text{Days of Data}}$

Figure 2. Calculation of Mean Pattern Blood Sugars in Third Trimester.

RESULTS

Table 1 lists means ± standard deviation for the 26 behavioral items on the group of 21 IDM's. Means from a sample of "normal" infants are listed and were taken from data reported by Als, et al. (1979). In all items except one (defensive movements) the IDM mean is within one SD of the value given for "normal" infants. Thus, it would initially appear that there were basically no differences in the two groups. However, it can also be noted that the standard deviations are much larger for the IDM group, reflecting wider individual variation within the IDM group than within the "normal" group. One explanation could be that "normals" were examined on day 3 whereas IDM's were examined between days 2 and 19. When IDM's examined on days 2-3 are compared within the "normal's, however, the variation persists.

Frequency distributions of selected items illustrate this property of high variability in the IDM group (Figures 3 and 4). In Figure 3, orientation to object, a larger number of IDM's performed at poor and excellent levels with few in the moderate (most common) range. In Figure 4, general motor tone, a large number of IDM's were hyper- or hypotonic (exaggerated reflexes or floppy), whereas most normal healthy infants fall in the moderate range.

The variability can be understood best through the cluster scores. Using an *a priori* clustering technique, infants are rated as: 1) excel-

Buckner, Williams, Nelson, and Huddleston

TABLE 1. Mean ± Standard Deviation for the 26 Behavioral Items on the Group of 21 IDM's.

ITEM	MEAN ± SD IDM n_max. = 21	MEAN ± SD NORMAL (from Als, et al.) DAY 3	MEAN ± SD IDM (day 2-3) n_max. = 9
Items indicating capacity for attention and social responsiveness:			
Orientation to object	6.4 ± 2.4	5.4 ± 1.5	7.2 ± 1.8
Orientation to inanimate sound	6.1 ± 2.2	5.8 ± 0.8	6.0 ± 2.0
Orientation to face	5.8 ± 2.6	6.5 ± 1.1	6.6 ± 2.5
Orientation to voice	6.4 ± 2.0	5.8 ± 1.9	6.0 ± 2.8
Orientation to face & voice	6.0 ± 2.4	6.9 ± 0.9	6.7 ± 2.3
Alertness	5.2 ± 2.6	5.5 ± 1.9	5.8 ± 2.6
Cuddliness	4.8 ± 2.1	5.8 ± 1.2	4.6 ± 2.2
Consolability	5.1 ± 1.9	6.2 ± 1.4	5.8 ± 2.3
Items indicating motor and tone capacity:			
Muscle Tone	5.3 ± 2.0	5.4 ± 1.0	5.0 ± 2.1
Activity Level	5.3 ± 1.9	4.6 ± 0.9	4.4 ± 2.0
Motor Maturity	4.7 ± 2.7	4.7 ± 0.9	4.6 ± 2.7
Hand to Mouth Facility	5.2 ± 2.5	6.0 ± 1.8	4.1 ± 2.8
Defensive Movement	4.6 ± 2.2	6.9 ± 1.3	3.8 ± 2.2
Pull-to-sit	5.0 ± 2.6	5.8 ± 1.3	4.6 ± 2.5
Items indicating capacity for controlling state of consciousness:			
Response Decrement to Light	6.6 ± 2.4	7.1 ± 1.5	5.6 ± 2.7
Response Decrement to Rattle	5.9 ± 2.7	6.8 ± 1.8	6.2 ± 3.3
Response Decrement to Bell	7.3 ± 2.0	7.1 ± 1.8	7.3 ± 2.9
Response Decrement to Pinpricks	2.4 ± 1.6	4.2 ± 1.2	2.5 ± 1.3
Rapidity of Build-up to Crying State	2.9 ± 1.9	3.6 ± 1.8	2.7 ± 2.1
Peak of Excitement	6.0 ± 1.7	5.8 ± 1.3	5.3 ± 1.9
Irritability	5.1 ± 2.7	4.0 ± 1.5	4.7 ± 2.6
Self-Quieting	5.2 ± 2.5	5.1 ± 1.5	6.1 ± 2.6
Lability of States	2.5 ± 0.8	2.8 ± 1.1	2.4 ± 1.1
Items indicating physiological response to stress:			
Startles	5.1 ± 2.5	4.3 ± 1.6	3.9 ± 2.0
Tremors	3.1 ± 1.8	4.4 ± 1.8	2.3 ± 2.2
Color Changes	5.0 ± 2.2	4.1 ± 1.2	5.1 ± 2.3

SCORE
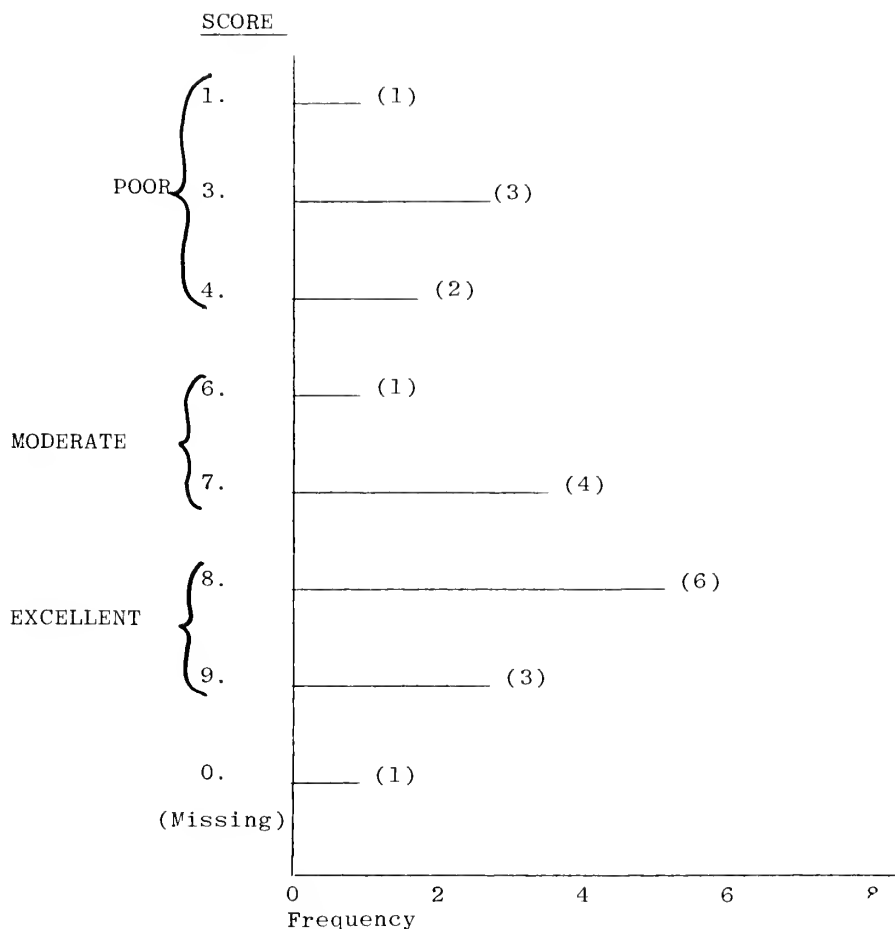
Figure 3. Orientation to object of IDM'S Responses were poor in 30% of
cases, moderate in 25% of cases, and excellent in 45% of cases.

lent, 2) good, or 3) poor in the four clinical clusters. By comparison
with normals, the IDM's had a higher incidence of poor performances. Com-
parisons and narrative descriptions are given in Table 2. In general,
there were over $3\frac{1}{2}$ times more poor performances in the IDM group than had
been reported for normal newborns; among normal newborns, reports show 13%
of performances are poor whereas the IDM's recorded 48% poor performances
on various clusters. There were more poor performances in each cluster
group and descriptions of characteristic behavior patterns are listed for
each cluster.
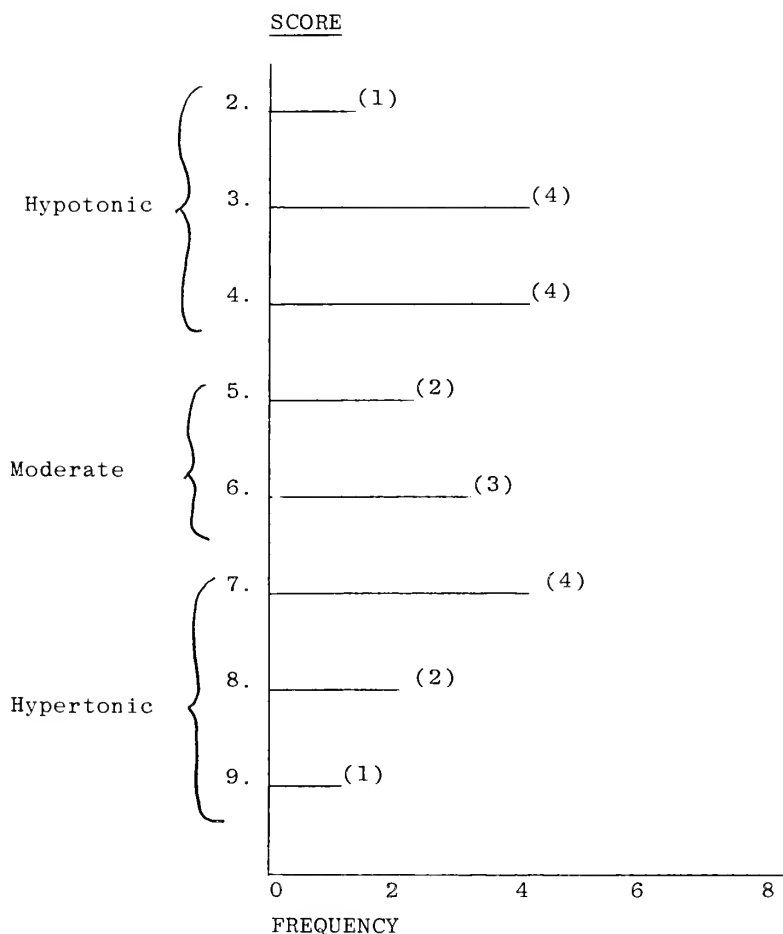
Figure 4. General Tone of IDM'S. Responses were hypotonic in 43% of cases, moderate in 24% of cases, and hypertonic in 33% of cases.

When behavioral cluster scores were correlated with mean blood sugar levels in excess of 100 mg % in the third trimester, it was found that there were significant correlations between behavioral scores and the fasting (7 AM) blood sugar levels in three of the clusters and in the summary score of the clusters. Correlations are listed with significance levels (p values) in Table 3. A scatter diagram of the relationship between mean fasting blood sugar and summary score indicates the degree of association between the two variables (Figure 5).

TABLE 2. Description of Variability in IDM Group Compared to "Normal"
Reported Values in Literature. Reported values are from Als,
et al. 1979.

Percentage of Infants with Summary Cluster Performance Below Average in
the Four Clusters

ALL CLUSTERS

Normal   13%

IDM   48%

INTERACTIVE PROCESSES

Normals   10%

IDM   29%

Characterized by Low Attention-Orientation

MOTORIC PROCESSES

Normals   2.5%

IDM   43 %

Characterized by Hyperactive Reflexes, Hypotonic General Tone, Low Motor
Maturity, Low Pull-to-Sit Ability

STATE CONTROL

Normals   12.5%

IDM-Type I Very Labile   19%

    Type II Flat Depressed   9.5%

    Total = 29%

PHYSIOLOGICAL RESPONSE TO STRESS

Normals   10%

IDM   29%

Characterized by Skin Color Changes and Startles

TABLE 3. Correlations Between Cluster Scores and Mean Pattern Blood Sugars.

VARIABLES	CORRELATION COEFFICIENT	SIGNIFICANCE LEVEL
BNBAS Summary Score x 7 AM	0.50	$p \leq .01$
Interactive Processes "	0.43	$p \leq .03$
Motoric Processes "	0.37	$p \leq .05$
State Control "	0.46	$p \leq .02$
Physiologic Response "	−.20	N.S.
Summary Score x 11 AM	.23	N.S.
Interactive Processes "	.05	N.S.
Motoric Processes "	.35	N.S.
State Control "	.15	N.S.
Physiologic "	−.05	N.S.
Summary x 4 PM	.07	N.S.
Interactive "	−.10	N.S.
Motoric "	.01	N.S.
State "	.02	N.S.
Physiologic "	.34	N.S.
Summary x 9 PM	−.13	N.S.
Interactive "	−.05	N.S.
Motoric "	−.13	N.S.
State "	−.36	N.S.
Physiologic "	.44	$p \leq .04$

FIGURE 5: CORRELATION BETWEEN BNBAS SUMMARY SCORE AND MEAN FASTING BLOOD SUGAR

r=.497
p≤.01

Mean Fasting Blood Sugar in Third Trimester
(mg% over 100mg%)

BNBAS CLINICAL CLUSTER SUMMARY SCORE

Poor 11

10

9

Average 8

7

Excellent 6

76
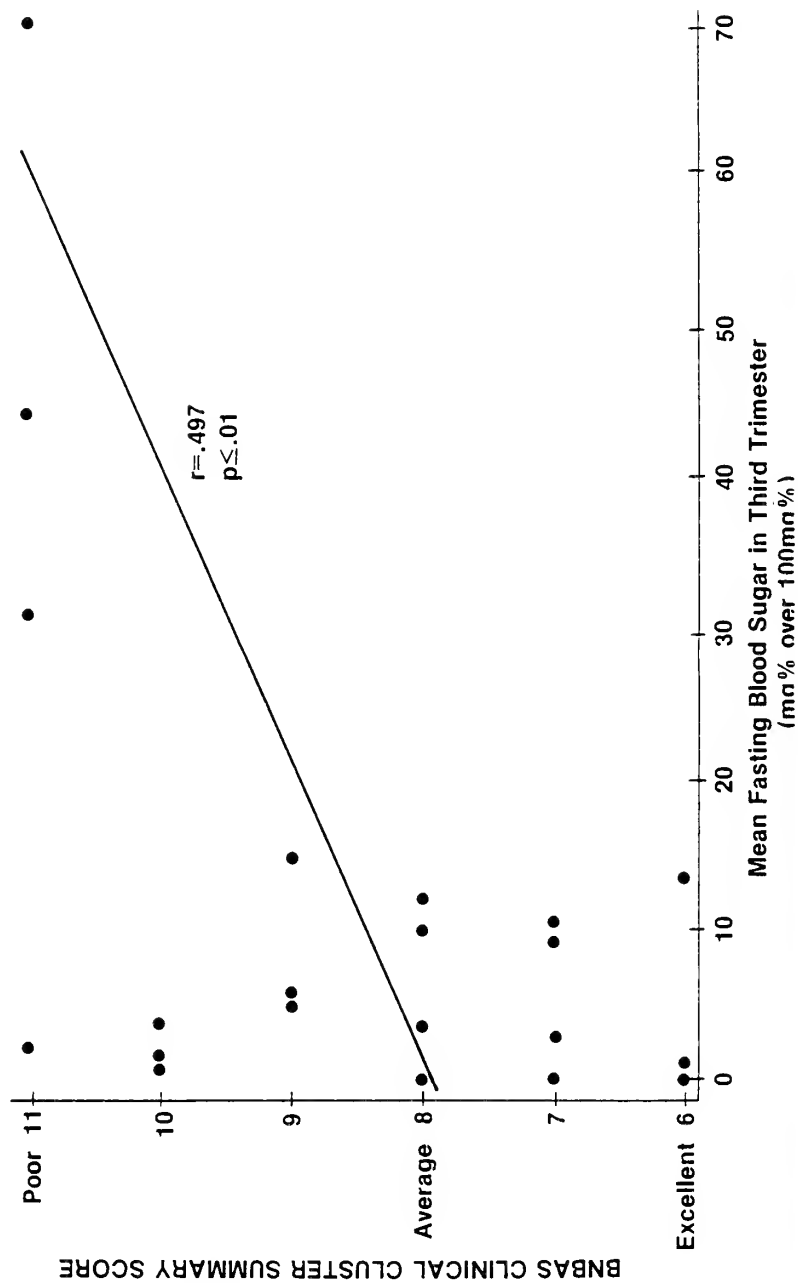
DISCUSSION

There was marked variability in the behavioral responses of IDM's
compared to normal controls. The IDM's exhibited many more poor perfor-
mances, although some demonstrated excellent abilities in one or more
clusters. The behavioral assessment provides a sensitive assessment of
the newborn's behavioral repertoire and is an integral part of a compre-
hensive assessment in planning care for parents and infants. Infants who
score poorly in specific clusters are characterized as relatively higher
risk with respect to the infant's input into the developing reciprocal
relationship. Particular nursing prescriptions for follow-up care include
demonstration of infant's current strengths and needs, validation of par-
ental perceptions, and anticipatory planning for modifications of home
environment, including use of toys and timing of interactions. Phone
follow-up or other referral may also be necessary (Buckner 1983).

There was a significant relationship between fasting maternal blood
sugar levels in the third trimester and the behavioral responses of the
neonates. Specifically, infants with consistently good to excellent per-
formance in several clusters had been nurtured in a fetal environment in
which the mean fasting blood sugar (FBS) was 100-114 mg %. All infants
exposed to high mean FBS's of 130-171 mg % demonstrated relatively poor
performances on the BNBAS. Since the BNBAS taps the infant's ability to
integrate complex stimuli and control own responses, the results may indi-
cate long-term effects of elevated maternal FBS on functioning of the in-
fant's CNS or may represent a transient influence on the early neonatal
period. Further research is needed to discriminate between these two
possibilities. Also, poor performances may be attributed to many other
variables besides fasting blood sugar, and repeat examinations are neces-
sary to confirm "below average" performances.

SUMMARY

The problems of diabetes in pregnancy and its effect on the woman,
fetus, child, and family are complex. The behavioral assessment taps the
infant's performance in areas indicative of cognitive and affective func-
tioning. It allows assessment across dimensions we believe are important
for future growth and development within social relationships. Evidence
has been presented for its use in health assessment during the transition
from intrauterine to extrauterine growth, but much future research is in-
dicated to confirm these relationships and to determine the sensitivity
and specificity of the behavioral assessments.

BIBLIOGRAPHY

Als, H., Tronick, E., Lester, B. M., and Brazelton, T. B. Specific Neo-
natal Measures: The Brazelton Neonatal Behavioral Assessment Scale in
J.D. Osofsky, ed. *Handbook of Infant Development*, New York: John Wiley
and Sons, 1979.

Buckner, E. B. Use of the Brazelton Neonatal Behavioral Assessment in
Planning Care for Parents and Newborns, *Journal of Obstetric Gynecologic
and Neonatal Nursing*, 1983, 12(1): 26-30.

Yogman, M. W., Cole, P., Als, H., and Lester, B. M.   Behavior of Newborns
of Diabetic Mothers.   *Infant Behavior and Development*, 1982, 5: 331.

THE APPLICATION OF TRACE FOSSILS AS INDICATORS OF WATER
DEPTH CHANGES IN THE UPPER CLIFF COAL INTERVAL[1]

Michael A. Gibson
Department of Geology
Auburn University
Auburn University, AL   36849

ABSTRACT

Trace fossils are commonly used as indicators of water depth accord-
ing to Seilacher's paleobathymetric model. Recent studies have shown some
discrepancies in the model and cast doubt on the model's usefulness as a
paleoecological technique. An example from the lower Pottsville Formation
(Pennsylvanian) of Alabama is used to demonstrate that, in spite of recent
arguments, the model remains a viable paleoecological tool when used in
conjunction with other evidence.
     The environment of deposition for the Upper Cliff coal interval in
Blount County has been worked out using both sedimentological evidence and
macroinvertebrate body-fossils. Bathymetric trends from brackish to shal-
low marine water, indicated by invertebrate body-fossils and sedimentolog-
ical evidence, are compared to bathymetric changes indicated by trace fos-
sil assemblages, and are in complete agreement. Although specific water
depths cannot be interpreted, relative changes in water depth can be in-
terpreted based upon trace fossil assemblages, sedimentological evidence,
and macroinvertebrate assemblages.

INTRODUCTION

The use of trace fossils as bathymetric indicators has become in-
creasingly popular since being proposed by Seilacher (1967). Seilacher
noted that trace fossils do not occur randomly, but in predictable assem-
blages associated with sedimentary structures. His paleobathymetric ichi-
nofacies model consists of six facies of trace fossil assemblages that he
considers indicative of specific environments at different bathymetric
levels (Figure 1). Numerous studies employing Seilacher's model have been
conducted (e.g., Chamberlain, 1971, 1978; Chaplin, 1980).
     Byers (1982) recently objected to the use of Seilacher's model point-
ing out some of the model's inconsistencies. He pointed out that Seilac-
her's model is based solely upon a highly simplified generalization ob-
served in the stratigraphic record. The underlying mechanism explaining
this ichnofacies pattern is unknown. Byers (1982) also contended the ob-
servation that trace fossil assemblages are directly or indirectly depth
related was presented by Seilacher (1967) without supportive evidence.
Osgood and Szumac (1972) also noted problems with Seilacher's model. They
noted that Seilacher's *Zoophycos* facies extends beyond the depth limits
indicated in the model, overlapping other trace fossil facies. They con-

---
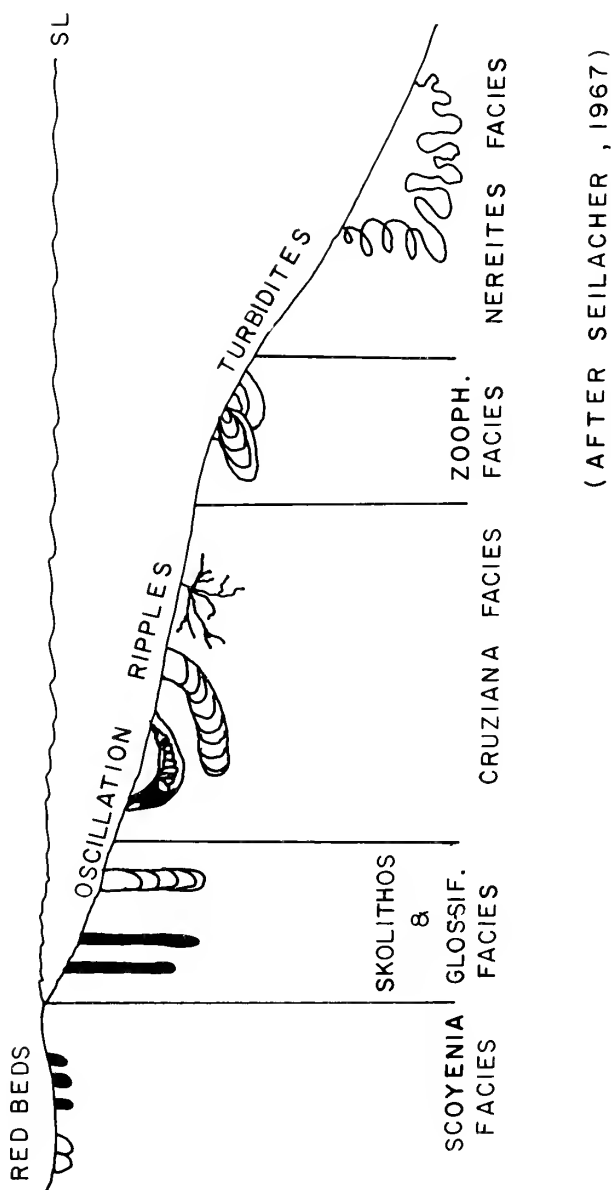
Figure 1. Paleobathymetric ichnofacies model (after Seilacher, 1967).

cluded that the use of the *Zoophycos* to indicate depth is hazardous at best. Other workers have noticed similar discrepancies (Ekdale, 1975; Chamberlain, 1978; Gibson, 1983).

The purpose of this study is to show that Seilacher's paleobathymetric model is still a viable and useful paleoecological technique, despite the above arguments. It should, however, be used in conjunction with other paleontological and sedimentological evidence. The model is best used as an indicator of relative depth or changes in depth rather than an indicator of any specific depth. An example from the Upper Cliff coal interval of the Pennsylvanian Pottsville Formation, northern Alabama is used.

STUDY AREA

The study area is located in Blount County, Alabama (Blountsville 7.5 minute quadrangle, SE1/4; Clarence 7.5 minute quadrangle, SW 1/4; Cleveland 7.5 minute quadrangle, NE 1/4; Oneonta 7.5 minute quadrangle, NW 1/4; Figure 2). The Upper Cliff coal interval in northern Alabama consists of sandstone, siltstone, shale, and coal deposited in a fluvio-deltaic environment (Gray, 1981; Gastaldo, 1982, in press; Gibson, 1982, 1983). A generalized stratigraphic section of the Upper Cliff coal interval in Blount County is shown in Figure 3.

Gray (1981) proposed a depositional model for the Upper Cliff interval in Jackson, Marshall, and Blount counties based upon stratigraphy and sedimentology. The lowest exposed lithofacies is a sandstone interpreted to represent a distributary channel (Gastaldo, in press). A rooted paleosol followed by the Upper Cliff #2 Coal overlies the distributary-sandstone lithofacies and is interpreted to represent peat-accumulating swamp conditions (Gray, 1981; Gastaldo, 1982, in press). Poorly-bedded siltstones containing siderite nodules and plant debris in the lower portions overlie the Upper Cliff #2 Coal and are interpreted to represent interdistributary-bayfill deposits resulting from inundation of the Upper Cliff #2 swamp environment (Gray, 1981; Gastaldo, 1982, in press). Reestablishment of swamp conditions is signalled by the paleosol and Upper Cliff #1 coal overlying the siltstone lithofacies (Gray, 1981).

A thick sequence of thinly-bedded shales and shaley-siltstones that coarsen upwards to fine-grained sandstones overlies the Upper Cliff #1 coal. Siderite nodules and plant debris are common in the lower portion of this lithofacies. Invertebrate body fossils and trace fossils become more abundant higher in the section. Gray (1981) interpreted this lithofacies as interdistributary-bayfill deposits. He cited the presence of marine invertebrates and trace fossils as evidence of marine conditions.

A massive fine-medium-grained, buff-colored sandstone overlies the shaley-siltstone lithofacies. The base of the sandstone lithofacies contains abundant invertebrate body fossils and trace fossils. Gray (1981) interpreted this lithofacies to represent marine reworked sands derived from the southwest-prograding fluvio-deltaic system.

METHOD OF INVESTIGATION

The environment of deposition of the invertebrate fossil-bearing shaley-siltstone and overlying sandstone lithofacies has recently been studied from its paleontological aspect (Gibson, 1983). Paleobathymetric
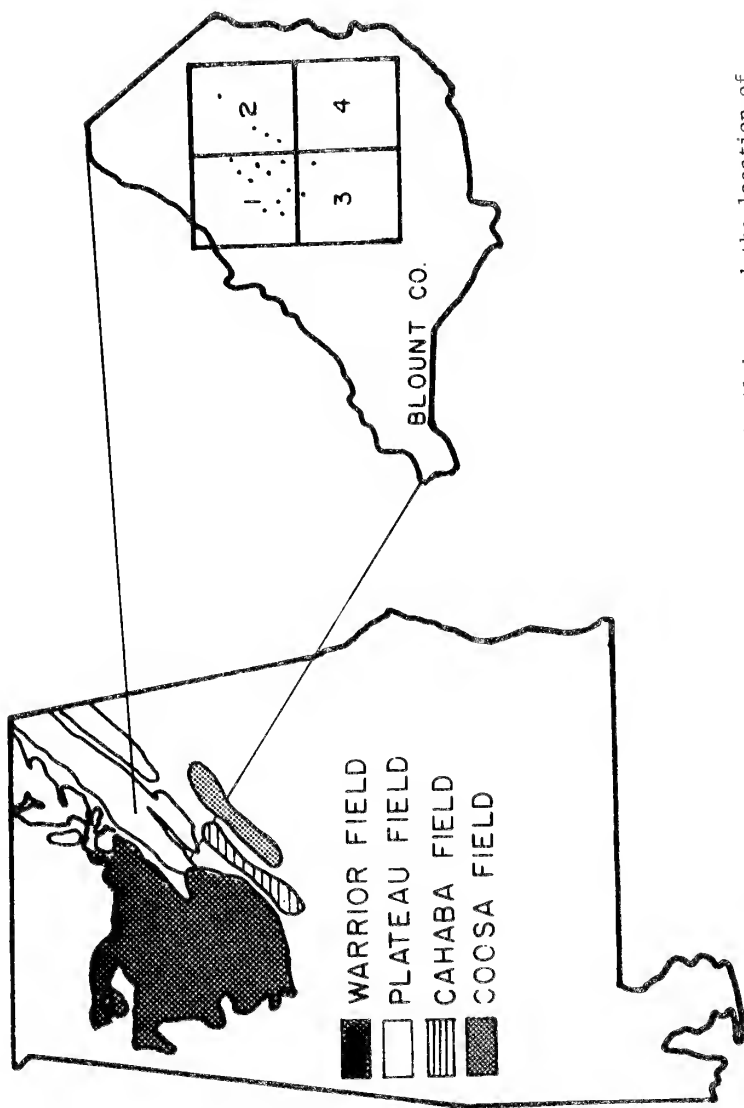
Figure 2. Map showing the four principle coal fields in Alabama and the location of the study area in Blount County. 1 - Blountsville 7.5 minute quadrangle, SE1/4, 2 - Clarence 7.5 minute quadrangle, SW1/4, 3 - Cleveland 7.5 minute quadrangle, NW1/4, 4 - Oneonta 7.5 minute quadrangle, NW1/4.

82

KEY

COAL		MASSIVE	
SILTSTONE		LAMINATED	
SANDSTONE		POORLY LAMINATED	
SHALE		SIDERITE NODULES	

BRACHIOPODS

LINGULA
ORBICULOIDEA
SCHIZOPHORIA
PUSTULA
RUGOSOCHONETES

MOLLUSCS

PTERONITES
WILKINGIA
AVICULOPECTEN
PALEYOLDIA
PROTHYRIS
STRAPAROLLUS

TRACE FOSSILS

ZOOPHYCOS
RHIZOCORALLIUM
UNIDENTIFIED

SCHIZOPHORIA ZONE

0 FEET
5
10
15
20
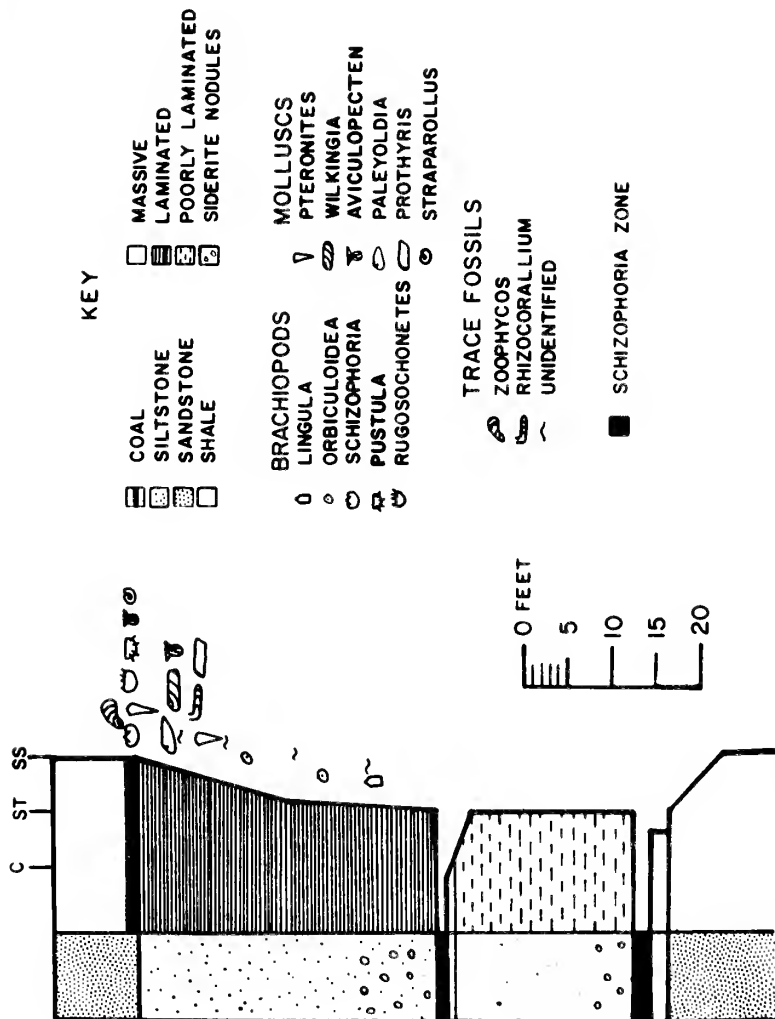
Figure 3. Generalized stratigraphic section of the Upper Cliff Coal interval in Blount County.

trends indicated by sedimentary structures, flora, and characteristic invertebrate body fossils are compared to paleobathymetric trends indicated by trace fossils according to Seilacher's (1967,1978) model.

McAlester and Rhoads (1967) noted that water depth can be inferred using such environmental variables as salinity, substrate nature, and taxonomic diversity. In this study, salinity is used as an indicator of relative depth or trends in depth.

Data concerning the depth and salinity characteristics of the characteristic taxa are summarized from Newell (1940); Degens and others (1957); Weller (1957); Williams (1960); Ferguson (1962); Johnson (1962); Ferm and Williams (1965); Roberts (1966); Calver (1968); Stanley (1968, 1970, 1972); Bretsky (1969); Whisonant (1970); Lee (1971); Hoare and Sturgeon (1972); Kindt (1974); Broadhead (1976); Tucker (1976); McKerrow (1978); Cherns (1979); Dennis and Lawrence (1979); and Hoare, Sturgeon, and Kindt (1979).

The stratigraphic position of some common invertebrate body fossils and trace fossils is shown in Figure 3.

RESULTS

A summary of the existing paleobathymetric and salinity data for the characteristic invertebrate taxa of each lithofacies if presented in Table 1. The characteristic invertebrate taxa occurring in each lithofacies are shown in Table 2.

Table 1. Interpreted Paleobathymetry and Salinity Requirements of the Upper Cliff Fauna.

Taxon	Paleobathymetry	Salinity
Brachiopods		
Lingula	Intertidal-Shallow	Brackish-Marine
Orbiculoidea	Shallow-Nearshore	Brackish-Marine
Schizophoria	Nearshore	Marine
Derbyia	Nearshore	Marine
Rugosochonetes	Nearshore to Shallow Shore	Marine
Pustula	Nearshore	Marine
Linoproductus	Nearshore	Marine
Bivalves		
Nucula	Offshore	Marine
Paleyoldia	Shallow Shelf	Marine
Pteronites	Intertidal-Shallow	Brackish-Restrict
Septimyalina	Shallow	Marine
Aviculopecten	Nearshore to Shallow Shelf	Restricted-Marine
Wilkingia	Shallow to Offshore	Restricted-Marine
Gastropods		
Euphemites	Intermediate-Offshore	Marine
Straparollus	Intermediate-Offshore	Variable
Palaeostylus	Intermediate	Variable

Table 2.   Characteristic Macroinvertebrate Genera From the Upper Cliff
          Coal Interval.

Shaley–Siltstone Lithofacies		Sandstone Lithofacies	
Brachiopods		Brachiopods	
Lingula	(R)*	*Schizophoria*	(A)
Orbiculoidea	(A)	*Pustula*	(O)
		Rugosochonetes	(O)
		Linoproductus	(R)
		Derbyia	(R)
		Orbiculoidea	(O–A)
Bivalves		Bivalves	
Pteronites	(A)	*Pteronites*	(R)
Aviculopecten	(O)	*Aviculopecten*	(O)
Wilkingia	(O)	*Wilkingia*	(R)
Prothyris	(R)	*Septimyalina*	(R)
		Dunbarella	(O)
		Astartella	(O)
		Edmondia	(O)
		Nucula	(O)
Gastropods		Gastropods	
None		*Palaeostylus*	(R)
		Straparollus	(R)
		Euphemites	(A)
		Bellerophon	(O)

* (A) = Abundant, (O) = Occasional, (R) = Rare

The lower shaley–siltstone lithofacies (Figure 3) is dominated by
trace fossils, the inarticulate brachiopods *Lingula* and *Orbiculoidea*,
which commonly occur in siderite nodules, and plant debris. The frag-
mented plant debris is very common on certain bedding surfaces and absent
on others. This lithofacies represents a terrestrial, swampy environment
alternating with a more strictly marine condition. The small nodular form
of the siderite nodules in the absence of extensive siderite bands present
within the lower shaley–siltstone lithofacies indicates brackish water
conditions (Weber and others, 1979). The inarticulate brachiopods *Lingula*
and *Orbiculoidea* also indicate shallow, nearshore, brackish water con-
ditions (Table 1).

Trace fossils within the lower shaley–siltstone lithofacies are domi-
nantly horizontal. The characteristic trace fossil genera include *Planol-
ites, Rhizocorallium, Conostichnus, Kouphichium, Chondrites, Scalarituba
Asterophycos. Planolites* and *Rhizocorallium* are the dominant trace
fossils within this lithofacies.

The upper shaley–siltstone lithofacies is devoid of plant debris and
only rarely contains siderite nodules. This is interpreted to represent a
transition to somewhat deeper–water conditions than the lower shaley–silt-
stone lithofacies, without much terrestrial plant input (Gibson, 1983).
The invertebrate fauna is relatively diverse and molluscan dominated (Fig-

ure 3). The dominant genera include *in situ Orbiculiodea* in the lower portions with *Pteronites, Aviculopecten*, and *Wilkingia* becoming dominant higher in the section. Although these taxa can tolerate a range of salinities and depths (Table 1), their occurrence immediately above brackish-water fauna and their lack of association with siderite nodules and plant fossils suggests a slightly more offshore deeper-water environment of deposition than the underlying shaley-siltstone lithofacies (Gibson, 1983).

The trace fossil fauna of the upper shaley-siltstone lithofacies is similar to the lower shaley-siltstone lithofacies. Characteristic ichnogenera include *Planolites, Rhizocorallium*, and *Chondrites* with *Rhizocorallium* and *Planolites* dominating. Near the top of the sequence, *Zoophycos* appears in rare instances.

The sandstone lithofacies (Figure 3) contains a transported basal shell bed called the *Schizophoria* zone (Gibson, 1983). The invertebrate fauna of the *Schizophoria* zone is brachiopod dominated, consisting of shallow water marine forms (Table 1). Nearly all of the transported taxa are epifaunal forms. The characteristic genera are *Schizophoria, Pustula, Linoproductus, Rugosochonetes, Derbyia, Aviculopecten, Straparollus, Palaeostylus, Septimyalina, Astartella*, and *Dunbarella*. Within the *Schizophoria* zone, rare occurrences of *in situ Pteronites* and *Wilkingia* are noted. Above the *Schizophoria* zone, shallower water invertebrates occur in minor abundance, especially near the top of the sandstone lithofacies.

No trace fossils are observed within the *Schizophoria* zone; however, the bedding surfaces immediately above this zone show densely packed *Zoophycos*. Higher within the sandstone lithofacies, *Zoophycos* begins to decline and *Rhizocorallium* increases in abundance.

DISCUSSION

The sedimentology and invertebrate paleontology of the shaley-siltstone lithofacies indicates a brackish water environment of deposition becoming more open marine (Gibson, 1983). The trace fossil assemblage preserved is dominated by rhizocorallid-type burrows and *Planolites*. The diversity and abundance of the trace fossils within the lower and upper shaley-siltstone lithofacies is great when compared to the sandstone lithofacies. The presence of *Rhizocorallium, Planolites, Conostichus, Asterophycos, Scalarituba, Chondrites* and the limulid *Kouphichnium* suggests that this lithofacies belongs to Seilacher's *Cruziana* association (Seilacher, 1967, 1978). The rare occurrence of *Zoophycos* within the upper few centimetes of the shaley-siltstone lithofacies can be explained by the burrowing of the *Zoophycos* aminal into underlying lithofacies from the overlying sandstone lithofacies (Chamberlain, 1978).

The invertebrate macrofauna of the basal portion of the sandstone lithofacies represents a continuing shift towards deeper-water conditions. Well-preserved transported marine epifauna within the *Schizophoria* zone, mixed with *in situ* euryhaline taxa from the shaley-siltstone lithofacies, indicates that the amount of transport of the marine epifauna was minimal (Gibson, 1983). Higher in the sandstone lithofacies, a more restricted marine fauna begins to occur (e.g., *Orbiculoidea*) signalling the beginning of a regressive phase.

The trace-fossil assmeblage of the sandstone lithofacies varies vertically. Bedding planes occupied solely by *Zoophycos* occur immediately above the *Schizophoria* zone. The ubiquitous occurrence of *Zoophycos* in the absence of other trace fossils is assignable to Seilacher's *Zoophycos* assemblage (Seilacher, 1967, 1978). The shift from the *Cruziana* to the *Zoophycos* assemblage represents a shift from shallow shelf to intermediate depths (Seilacher, 1967, 1978). These terms can only be used relatively, however, because no indicators of absolute depth are present. Higher in the sandstone lithofacies, rhizocorallid burrows begin to dominate, suggesting the beginning of a regressive phase. This observation is supported by the reappearance of shallower water invertebrates within this portion of the sandstone lithofacies.

CONCLUSION

The trace fossils within the Upper Cliff Coal interval of Blount County record a shift from Seilacher's (1967, 1978) *Cruziana* facies to the *Zoophycos* facies. According to the model, this corresponds to a shift from shallow shelf to intermediate depths. Invertebrate macrofossils, plant fragments, and the distribution of siderite nodules indicate a shift from relatively shallow brackish water conditions to slightly deeper water conditions indicated by the proximity of a well-preserved open marine epifauna. However, absolute depth cannot be determined because many of the dominant invertebrates are euryhaline and eurybathic (Table 1). Only a shift toward relatively deeper-water conditions can be inferred for the Upper Cliff interval. A return to the *Cruziana* facies and more restricted invertebrate taxa signals a regressive shift to shallower-water conditions.

Seilacher's (1967, 1978) paleobathymetric model is a viable paleoecological technique when used in conjunction with other paleoecological and sedimentological evidence. As Byers (1982) points out, we can assume that the behavior of the organism producing the trace is controlled by physical conditions, but we need to prove that depth is the major factor. The availability of organics also affects trace fossil distribution. The relative amount of organics and clastics increase shoreward. This may explain the abundance of trace fossils within the shaley-siltstone lithofacies. The marine environment is controlled by interactions of factors such as salinity, depth, temperature, geography, currents, turbulence, substrate conditions, and more. Depth is only one of these factors and does not act independently; therefore, an interdisciplinary approach is best.

REFERENCES CITED

Bretsky, P. W. Jr. 1969. Evolution of Paleozoic benthic marine invertebrate communities. Paleogeography, Paleoclimatology, Paleoecology. 6: 45-59.

Broadhead, T. W. 1976. Depositional systems and marine benthic communities in the Floyd Shale, Upper Mississippian, northwest Georgia. In, Scott, R. W. and West, R. R. (eds.). Structure Classification of Paleocommunities. Dowden, Hutchinson, and Ross Publishers. Stroudsberg, Pennsylvania. 265-280.

Byers, C. W. 1982. Geological significance of marine biogenic sedimentary structures. In, McCall, P. L. and Tevesz, M. J. (eds.). Animal-Sediment Relations. Plenum Press, Inc. New York. 233-238.

Calver, M. A. 1968. Distribution of Westphalian marine fauna of northern England and adjoining areas. Proceedings of the Yorkshire Geological Society. 37:1-72.

Chamberlain, C. K. 1971. Bathymetry and paleoecology of Ouachita geosyncline of southeastern Oklahoma as determined from trace fossils. American Association Petroleum Geologists Bulletin. 55:34-50.

Chamberlain, C. K. (ed.). 1978. A guidebook to the trace fossils and paleoecology of the Ouachita geosyncline. Society Economic Paleontologists and Mineralogists Field Trip.

Chaplin, J. R. 1980. Stratigraphy, trace fossil associations, and depositional environments in the Borden Formation (Mississippian), northeastern Kentucky. Annual Field Conference of the Geological Society of Kentucky.

Cherns, L. 1979. The environmental significance of *Lingula* in the Ludlow Series of the Welsh Borderland and Wales. Lethaia. 12:35-46.

Degens, E. T., Williams, E. G., and Keith, M. L. 1957. Environmental studies of Carboniferous sediments, Part I, geochemical criteria for differentiation of marine from freshwater shales. American Association of Petroleum Geologists Bulletin. 41:2425-2427.

Dennis, A. M. and Lawrence, D. R. 1979. Paleoecology in the Megoffin marine zone, Pennsylvanian Breathitt Formation, near Hazard, Kentucky. In, Ferm, J. C. and Horne, J. C. Carboniferous depositional environments of the Appalachian Region. University of South Carolina Department of Geology, Columbia, South Carolina. 256-258.

Ekdale, A. A. 1975. Trace fossils in leg 42A cores. Initial Reports Deep Sea Drilling Project. 42:821-827.

Ferguson, R. G. 1962. Paleoecology of a Lower Carboniferous marine transgression. Journal of Paleontology. 36:1090-1107.

Ferm, J. C. and Williams. 1965. Characteristics of a Carboniferous marine invasion in western Pennsylvania. Journal of Paleontology. 35:319-330.

Gastaldo, R. A. 1982. A preliminary assessment of the early Pennsylvanian maegafloral paleoecology in northeastern Alabama. In, Mamet, B. and Copeland, M. J. (eds.). Third North American Paleontological Convention Proceedings. 1:187-192.

Gastaldo, R. A. in press. Upper Carboniferous paleoecological reconstructions: observation and reconsiderations. 10th International Congress Carboniferous Stratigraphy and Geology Madrid, Spain.

Gibson, M. A. 1982. A preliminary study of the invertebrate megafauna associated with the Upper Cliff coals (early Pennsylvanian) Plateau Coal Field, northern Alabama (abstr.). Journal of Alabama Academy of Science. 53:51.

Gibson, M. A. 1983. The paleontology and paleoecology of the invertebrate megafauna associated with the Upper Cliff coals, Plateau Coal Field, norther Alabama. Unpublished M.S. Thesis. Auburn University, Auburn, Alabama. 181 p.

Gray, T. D. 1981. Depositional systems of the Upper Cliff coals in a portion of the Plateau Coal Field, nothern Alabama. Unpublished M.S. Thesis. Auburn University, Auburn, Alabama. 129 p.

Hoare, R. D. and Sturgeon, M. T. 1972. *Pteronites americana* (Meek) from the Brush Creek (Conemaugh), southeastern Ohio. Compass. 49:61-64.

Hoare, R. D., Sturgeon, M. T., and Kindt, E. A. 1979. Pennsylvanian marine bivalvia and rostroconchia of Ohio. Ohio Division Geological Survey Bulletin 67:77 p.

Johnson, R. G. 1962. Interspecific association in Pennsylvanina fossil assemblages. Journal of Geology. 79:32-55.

Kindt, E. A. 1974. Bivalvia of the Allegheny Group (Pennsylvanian) in Ohio. Unpublished M.S. Thesis. Bowling Green State University, Bowling Green, Ohio. 227 p.

Lee, Chun-Sun. 1971. Pottsville gastropods of Ohio. Unpublished M.S. Thesis. Ohio University, Columbus, Ohio. 129 p.

McAlester, A. L. and Rhoads, D. C. 1967. Bivalves as bathymetric indicators. Marine Geology. 5:383-388.

McKerrow, W. S. (ed.). 1978. The Ecology og Fossils. MIT Press. Cambridge, Massachusetts. 384 p.

Newell, N. D. 1940. Invertebrate fauna of the late Permian Whitehorse Sandstone. Geological Society of America Bulletin 51:261-335.

Osgood, R. G., Jr. and Szumac, E. J. 1972. The trace fossil *Zoophycos* as an indicator of water depth. Bulletin of American Paleontology. 62.

Roberts, H. H. 1966. A paleoecological study of a Lower Allegheny Shale in eastern Ohio. Unpublished M.S. Thesis. Louisiana State University, Baton Rouge, Louisiana.

Seilacher, A. 1967. Bathymetry of trace fossils. Marine Geology. 5: 413-429.

Seilacher, A. 1978. Use of trace fossil assemblages for recognizing depositional environments. In, Basin, P.B. (ed.). Trace Fossil Concepts. Society Economic Paleontologists and Mineralogists Short Course No. 5: 167-181.

Stanley, S. M. 1968. Post-Paleozoic adaptive radiation of infaunal bi-valve molluscs-a consequence of mantle fusion and siphon formations. Journal of Paleontology. 42:214-229.

Stanley, S. M. 1970. Shell form and life habits of the bivalvia (Mol-lusca). Geological Society of America Memoir 125.

Stanley, S. M. 1972. Functional morphology and evolution of byssally attached molluscs. Journal of Paleontology. 46:165-212.

Tucker, J. K. 1976. Paleoecological notes on the fauna of the Shumuray Limestone (Mattoon Formation, Upper Pennsylvanian) of Illinois. Trans-actions of the Illinois State Academy Science. 69:327-335.

Weber, J. N., Williams, E. G., and Keith, M. L. 1979. Paleoenvironmental significance of carbon isotope composition of siderite nodules in some shales of Pennsylvanian age. In, Ferm, J.C. and Horne, J.C. (eds.). Car-boniferous Depositional Environments in the Appalachian Region. Depart-ment of Geology, University of South Carolina. 110-120.

Weller, J. M. 1957. Paleoecology of the Pennsylvanian period in Illinois and adjacent states. In, Ladd, H. S. (ed.). Treatise on Marine Ecology and Paleoecology. 2. Geological Society of America Memoir 67:325-364.

Whisonant, R. C. 1970. Paleoecology and depositional environments of the Parkwood Formation, central Alabama. Southeastern Geology. 12:135-149.

Williams, E. G. 1960. Marine and fresh water fossiliferous beds in the Pottsville and Allegheny groups of western Pennsylvania. Journal of Pal-eontology. 34:908-922.

ECONOMIC ANALYSIS OF THE BOVINE BRUCELLOSIS
ERADICATION PROGRAM IN ALABAMA[1]

Vernon Joseph and Gregory Sullivan
*Department of Agricultural Economics
and Rural Sociology
Auburn University
Auburn University, Alabama 36849*

INTRODUCTION

The spending on government programs to control animal and plant dis-
eases, parasites and other pests that reduces agricultural production,
amounts to more than $150 million annually. (Emerson and Plato, 1978).
Over the past few years, the cost of conducting these programs have in-
creased tremendously, and officials have become more concerned now than
ever about these spiralling costs. Lui pointed out that with increasing
pressure to reduce federal spending, public decision-makers urgently need
reliable aggregate measures of performance of their programs.
In 1979 state and federal authorities spent $118 million in trying to
control bovine brucellosis. During that same year Alabama, with about 200
infected herds, lost over $2 million from bovine brucellosis. This loss
accounted for approximately 5 percent of the national losses.
The first objective of this analysis is to show the net benefits that
would accrue to the state of Alabama from public investment in a brucello-
sis eradication program. The second objective is to measure the change in
producers' and consumers' surpluses that would occur as a result of the
eradication program.

REVIEW OF LITERATURE

The use of benefit-cost analysis and general equilibrium analysis is
rapidly becoming popular for evaluating human and animal health projects.
One of the most recent benefit-cost analysis studies of brucellosis was
published by Beal et al. in 1977. The authors compared seven program al-
ternatives and the results indicated that the 10-year eradication program
yielded a B/C ratio 10.67, the highest when compared to the other programs
evaluated.
In 1976 McCauley et al. were the first to utilize the concept of pro-
ducers and consumers surpluses in the study of Foot and Mouth Disease
(FMD). This was followed by Lui in 1978 and Amosson et al. 1978 in their
studies of bovine brucellosis control. In these studies the change in
physical losses was used as supply shifters in a general equilibrium sup-
ply and demand model, and the effect on prices was estimated. Using these
data the change in producers' and consumers' surpluses were readily quan-
tified.

METHODS

The study was divided into two components. First, an epidemiological model developed for the National Brucellosis Technical Commission (NBTC) was utilized to calculate physical losses of beef and milk by simulating the biological effects of brucellosis on the cattle population over a period of 18 years in Alabama (Amosson et al.). Two important mathematical functions were used to calculate the spread of the disease within the cattle population. A modified version of the double binomial probability function was used to calculate the probability of infection by purchasing an infected replacement animal (Beal 1979). Another method in which a clean herd could become infected was via contact with infected neighboring herds (Amosson et al.). The Market Cattle Identification (MCI) program and the Brucellosis Ring Test (BRT) are the two primary surveillance methods used in the detection of the disease. Rates of detection were estimated from statistics collected from the state's veterinarian office.

The second component of the study was the methods used for economic analysis. Using an 18-year simulation period and a discount rate of 10 percent, the benefit-cost ratio and net present values for the accelerated eradication program were calculated.

The formula for the benefit-cost ratio is given in Equation 1.

$$(1) \quad B/C = \frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}} = \frac{\sum_{t=1}^{N} \dfrac{B_t}{(1+i)^t}}{\sum_{t=1}^{N} \dfrac{C_t}{(1+i)^t}}$$

where:

B_t = Benefits in year t
C_t = Costs in year t
i = Discount rate
N = Last year for which benfits and costs are computed
t = Years in the simulation runs with t = 1, . . . 18

The formula for Net Present Value is defined as:

$$(2) \quad NPV = \sum_{t=1}^{N} \frac{B_t - C_t}{(1+i)^t}$$

Where B_t, C_t, i, t and N are defined above.

To estimate producers' and consumers' surpluses, an econometric demand model representing the beef industry was used to measure the impact of supply changes in prices. A linear demand equation was estimated by Ordinary Least Squares (OLS) (Eq. 3). The data used for this study covered the period 1955 through 1982. Average annual prices paid to farmers for beef, chicken and pork were reported by the Alabama Statistical Reporting Service. Annual per capita disposable income was taken from Agricultural Statistics. The linear economic model was:

(3) $Q_{dt} = b_0 + b_1 P_1 t + b_2 P_2 t + b_3 P_3 t + b_4 Y_t + e_t$

where:

Q_{dt} = Quantity demanded, pounds in time period t
P_{1t} = Deflated producer price for beef, cents per pound in time
   period t
P_{2t} = Deflated producer price for pork, cents per pound in time
   period t
P_{3t} = Deflated producer price for chicken, cents per pound in time
   period t
Y_t = Deflated disposable income, dollars per capita in time period t
e_t = Error term
t = 1, 2, 3, . . . 27, for years 1955-1982

With the use of trend analysis, prices for chicken, pork and quanti-
ties of beef were estimated for the years 1983 to 2000. The estimated
quantity of beef produced in each year was used as a base from which simu-
lated losses with and without an eradication program were subtracted. The
forecasted production of beef and prices of substitutes were used to esti-
mate the price of beef in each year of simulation.

For the dairy subsector, trend analysis based on time series data
from 1952 to 1982 was used to forecast levels of milk production from 1982
to 2000. The simulation model estimated losses with and without an eradi-
cation program and these values were subtracted from the forecasted total
production. Based on a regression equation (Eq. 4) of quantities of milk
produced, the milk price was estimated for the period of 1982 to 2000.

(4) $P_{mt} = f(Q_{mt})$

where:

P_{mt} = Price of milk in time period t
Q_{mt} = Quantity of milk produced in Alabama in year t
t = 1, 2, 3, . . . 29, for years 1952-1982

These results were then used to calculate the change in producers' (PS)
and consumers' surpluses (CS), as given in equations 5 and 6 and illustra-
ted in Figure 1 (Anderson).

(5) $\Delta CS = (P-P_1)(Q+Q_1)/2$

(6) $\Delta PS = [(P_1-S)Q_1/2] - [(P-S)Q/2]$[1]

For example, Figure 1 shows the impact on price from quantity changes in
the beef sector based on conceptual model by Amosson et al. It is assumed
that the intercept remains the same for linear supply and demand curves
(Lindner and Jarrett). In Figure 1, let line DD represent the demand
curve and SS represent the supply curve for the commodity, under the no-
program option. With the initiation of the accelerated program, the sup-
ply curve will shift downward because of an increase of the commodity.
This new supply schedule is represented by SS_1. Because prices would be
lowered from P to P_1, consumers would increase the commodity purchases

from Q to Q_1. Therefore, consumers' surplus would increase by the area PEE_1P_1 and the change in producers' surplus is represented by the difference between areas PSE and P_1SE_1.
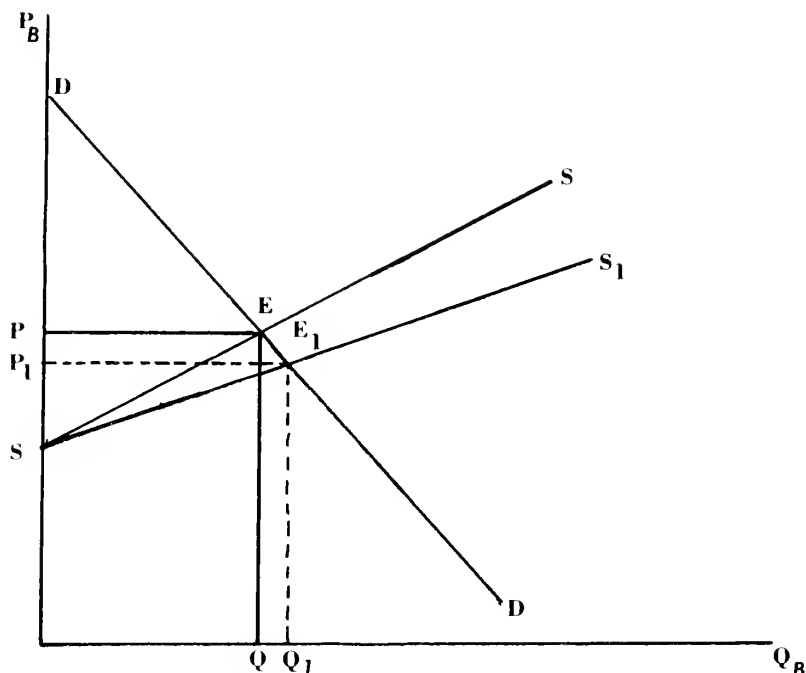
Figure 1. A graphic illustration of consumers' and producers' surplus.

For the accelerated program, costs were defined as those expenditures incurred by the state and federal governments plus an estimate of costs incurred by the beef and dairy producers to combat bovine brucellosis. Trend line analysis was used to estimate federal and state expenditures for brucellosis for the period 1982-2000. Producers costs were estimated from responses to a mail questionnaire relating to management proactices and costs mailed to a group of beef and dairy producers in Alabama whose herds had been infected or were presently infected.

The benefits of each program were measured in terms of the savings in physical losses of beef and milk due to the implementation of each alternative program. The physical losses reported from the model were represented as pounds of weaner calf losses due to abortions, lightweight calves, delayed calving intervals and reduced milk production.

Data Sources

Several sources were used to collect information on the impact of the brucellosis program in Alabama. A mail questionnaire was used to collect data, which were helpful in deriving producer-management costs and some production loss coefficients. The state veterinarian's office in Montgomery supplied data on state and federal expenditures to control brucellosis.

Issues of Alabama's *Agricultural Statistics* (1962-1981) and *Census of Agriculture* of Alabama were used in conjunction with data from the National Brucellosis Task Force Commision (NBTC) study to derive the production loss coefficients for setting the base year conditions for the simulation runs.

RESULTS

The simulation model projected the losses under the present eradication program in Alabama. Table 1 shows that annual beef losses were reduced in year 2000 to 3 percent of the 1983 value as opposed to the increase in losses from a no program option shown in Table 2. The same pattern was seen in the dairy industry when the accelerated and no-program options were evaluated. The model indicated a rapid rate of losses in milk production because of the potential high spread rates of the disease.

Table 1. Projected physical losses from brucellosis for beef and dairy herds under an "accelerated program," Alabama.

Year	Weaner Calf Losses	Dairy Calf Losses	Milk Losses
	- - - - - - - - - - - (Lbs) - - - - - - - - - - - - - -		
1982[a]	884,733	12,357	1,547,316
1983	393,891	456	37,100
1984	261,939	475	38,686
1985	175,284	206	16,732
1986	130,818	163	13,250
1987	105,459	123	13,250
1988	86,191	103	8,374
1989	75,745	90	7,290
1990	66,483	80	6,490
1991	52,268	65	5,322
1992	40,670	51	4,186
1993	34,799	43	3,480
1994	30,327	37	2,984
1995	25,564	31	2,530
1996	20,825	25	2,060
1997	18,145	22	1,753
1998	15,607	18	1,493
1999	13,176	15	1,256
2000	11,249	13	1,066

[a] 1982 was the base year for the simulation model.

Table 2. Projected physical losses from brucellosis for beef and dairy
herds under "no program," Alabama.

Year	Weaner Calf Losses	Dairy Calf Losses	Milk Losses
	- - - - - - - - - - - - Lbs - - - - - - - - - - - - - - - -		
1982[a]	1,040,579	24,837	964,308
1983	1,558,585	55,810	2,120,556
1984	2,432,249	136,345	4,954,707
1985	3,777,070	285,196	11,238,150
1986	5,747,497	470,475	19,713,790
1987	8,448,449	635,132	27,988,200
1988	11,831,450	737,642	33,479,120
1989	15,678,290	797,306	36,485,610
1990	19,700,360	847,336	38,795,370
1991	23,690,270	900,863	41,166,330
1992	27,583,120	962,238	43,857,040
1993	31,582,460	1,032,656	46,948,860
1994	35,797,180	1,112,412	50,462,480
1995	40,275,230	1,201,912	54,413,610
1996	45,082,960	1,302,060	58,835,630
1997	50,293,240	1,414,256	63,787,480
1998	55,984,910	1,540,203	69,343,020
1999	62,244,730	1,681,887	75,588,590
2000	69,169,610	1,841,617	82,624,720

[a]1982 was the base year for the simulated model.

Benefit-Cost Analysis

The changes in benefits, marginal program costs, benefit-cost ratios
and net benefits for the accelerated program are illustrated in Table 3.
Using the above mentioned criteria, the accelerated program was far more
desirable than the no program option. The savings in animal products from
an accelerated program was $185.756 million that would otherwise have been
physical losses. The discounted value of cumulative costs was approxi-
mately $44 million. The program costs will be compared later with changes
in consumer surplus over the same time period.

The accelerated program yielded a benefit-cost ratio of 4.166 which
is compared to the research findings of Amosson et al. In terms of net
present value of the stream benefits, the accelerated program was again
superior, yielding $141.171 million by the year 2000 compared to what
would have been a loss of -$331.8 million if no-program had been in ef-
fect. The costs of the no-program would have been even greater if costs
for human illness had been included.

Welfare Analysis

An econometric demand model and trend-line analysis were used to
develop a set of estimates under the accelerated program to assess the
impact associated with the no program option. The estimated regression
equation for beef is found in Eq. 7.

Table 3. Benefit-cost ratio and net present value at the end of year 2000.

Item	Accelerated Program
Change in Benefits (million $)	185.756
Program Costs (million $)	44.585
B/C Ratio	4.166
Net Present Value (million $)	141.711

$$(7) \quad Q_d = 31549.85 - 6155.03P_1* + 6865.90P_2* - 5659.1P_3* + 121.23 Y*$$

$$(39193.7) \quad (1235.4) \quad (2025.0) \quad (1678.1) \quad (48.6)$$

$$R^2 = .952 \qquad F = 99.24$$

(*Indicates significance at the 5 percent level.)

It should be noted that with the exception of the variable for poultry price, P_3, the expected signs of all other variables conformed to the expected relationships. Tables 4 and 5 show the effect on supply and price of beef and milk, respectively, if a no-program operation is put into effect. The supplies of beef over the 18-year period was 69 million pounds lower with the no-program option, and the price increased 11.33 cents per pound in the year 2000.

The quantity of milk in the dairy industry decreased by 83 million pounds over the 18-year period with no-program in effect. This resulted in an increased consumer price of 2.41 cents per hundred weight. This small increase was partially due to the projected decline in milk consumption even in the absence of brucellosis.

Equations 5 and 6 in the methodology were used to estimate the change in producers' and consumers' surpluses. Table 6 shows the net benefits accruing to society in terms of producers' and consumers' surplus if the no-program option were put into effect. For all years the change in consumers' surplus was negative while producers' surplus was positive. However, producers' surplus was not enough to offset the losses suffered by consumers. This was expected since the no-program option would increase infection, thereby decreasing supplies of beef and milk. This would then increase commodity prices which would not be beneficial to consumers, but would benefit producers with higher prices.

The effect of the no-program option on society is seen as devastating, with enormous social welfare costs. The magnitude of these losses by consumers indicates that it would benefit consumers to compensate producers to participate in the eradication program.

Table 4. Estimated effects of accelerated and 'no-program' options on supply and price of beef.

Year	Supply of Beef		Price of Beef	
	Accelerated	No-Program	Accelerated	No-Program
	- - - - (000 Lbs) - - - - - -		- - - - (cents/Lbs) - - - - -	
1983	682,908	681,743	51.31	51.50
1984	692,371	690,200	55.05	55.35
1985	701,835	698,233	58.80	59.39
1986	711,299	705,682	62.55	63.48
1987	720,762	712,419	66.29	67.70
1988	730,226	718,484	70.04	72.02
1989	739,690	724,088	73.79	76.34
1990	749,154	729,520	77.53	80.76
1991	758,617	734,979	81.27	85.17
1992	768,081	740,538	85.02	89.57
1993	777,545	745,997	88.77	94.00
1994	787,008	751,241	92.51	98.45
1995	796,472	756,222	96.26	102.94
1996	805,936	760,874	100.00	108.24
1997	815,399	765,124	103.75	112.09
1998	824,863	768,894	107.49	116.78
1999	834,327	771,995	111.23	121.48
2000	843,790	774,632	114.97	126.30

Table 5. Estimated effect of accelerated and 'no-program' options on supply and price of milk.

Year	Supply of Milk		Price of Milk	
	Accelerated	No-Program	Accelerated	No-Program
	- - - -Million Lbs- - - - -		- - - - - cents/Lbs - - - - -	
1983	510	508	15.87	15.93
1984	487	482	16.54	16.70
1985	464	453	17.21	17.53
1986	441	421	17.88	18.44
1987	418	390	18.55	19.36
1988	396	363	19.19	20.15
1989	373	337	19.86	20.91
1990	350	321	20.53	21.66
1991	327	286	21.20	22.39
1992	304	251	21.87	23.12
1993	281	234	22.54	23.91
1994	259	209	23.18	24.63
1995	236	182	23.85	25.42
1996	215	146	24.46	26.47
1997	190	126	25.19	27.05
1998	168	99	25.83	27.84
1999	145	69	26.50	28.71
2000	122	39	27.17	29.58

Table 6. Changes in producers' and consumers' surpluses of beef and milk
          occurring from going from an accelerated to a 'no-program', 1983
          through 2000.

Year	Change in Consumer Surplus	Change in Producer Surplus	Difference
	$		
1983	-1,527,831	497,448	-1,030,383
1984	-2,827,277	632,796	-2,194,481
1985	-4,904,279	1,347,122	-3,557,157
1986	-7,695,372	2,037,696	-5,657,676
1987	-10,999,915	1,990,567	-9,009,348
1988	-14,359,357	3,460,391	-10,898,966
1989	-21,132,840	5,370,739	-15,762,101
1990	-20,910,384	4,439,035	-15,994,424
1991	-23,045,134	4,407,773	-18,313,697
1992	-25,753,694	4,767,877	-20,575,276
1993	-28,299,835	5,010,395	-22,915,655
1994	-30,742,443	5,678,018	-25,064,425
1995	-28,461,812	5,768,818	-22,692,994
1996	-39,434,083	7,186,492	-32,247,591
1997	-38,338,386	5,977,734	-32,360,652
1998	-36,862,656	4,174,331	-32,688,325
1999	-43,839,741	5,966,232	-37,873,509
2000	-46,818,190	5,967,332	-40,850,858

CONCLUSION AND POLICIES

The results indicated that the Accelerated Brucellosis Eradication
program yields significantly increased benefits over the no-program op-
tion. Although the results estimated under these programs are under
strict assumptions of the disease control factors (MCI, BRT, and clean-up
rates) remaining at their present levels, the disease cannot be totally
eradicated within the time period specified in the analysis. Therefore,
if the eradication goal is to be realized in a reasonable period of time,
it is important that the control and surveillance method be maintained at
its present or even higher levels.

If support by state and federal authorities is discontinued, the cost
over the 18-year period could by very devastating to consumers. Although
such a situation is unlikely to occur, the losses of $331 million project-
ed under the No-Program option give an indication of how economically un-
favorable it could be to society as a whole.

The large negative impact on consumers' surpluses indicates that it
would be in the best interest of consumers to compensate producers to
participate in the State-Federal Brucellosis Program. Producers are being
compensated now because this program is being paid partially for by Ala-
bama taxpayers.

The nature of brucellosis disguises the direct cost to producers be-
cause of negative effects on herd reproduction can be harder to detect.

Therefore, this may cause resistance by some producers to adhere to the program procedures. To alleviate this problem, an education program is needed to explain to the farmer about brucellosis and its consequences. Education of consumers in Alabama is also necessary for support of State funds. The magnitude of the benefit-cost ratio is evidence enough to encourage consumers' support of this program. The net present value of the stream of net benefits of $141.711 million far outweighs the discounted program costs for the same time period.

Management is a key to control and eradication of the disease. The brucellosis program has the capability of increasing a producer's average returns. A manager needs to realize the benefits at the farm level for having an accelerated program by not incurring added costs of protecting the herd from outside infection. Adherence to the eradication program can lead to lower production costs and maintain the farmers' competitive edge.

LITERATURE CITED

Amosson, S. H., R. A. Dietrich, and J. A. Hopkin. Report-National Brucellosis Technical Commission, Appendix B, Benefit-Cost Analysis prepared for APHIS, USDA, 1978.

Anderson, J. E. "A Note on Welfare Surplus and Gains from Trade in General Equilibrium," *American Economic Review* 64(1974):758-762.

Beal, V. and H. Kryder. Brucellosis Program Analysis. APHIS, USDA, Haittesville, Maryland, 1977.

Emerson, P. E. and G. E. Plato. "Social Returns to Disease and Parasite Control in Agriculture: Witchweed in the U.S." *Agricultural Economics Research* 30(1978):15-22.

Lindner, R. K. and F. G. Jarrett. "Supply Shifts and the Size of Research Benefits," *American Journal of Agricultural Economics* 60(1978):48-58.

Lui, C. "An Economic Impact Evaluation of Government Programs: The Case of Brucellosis Control in the United States." *Southern Journal of Agricultural Economics*. July, 1979.

McCaulley, E. H., W. B. Sundquist, N. Aulaqi, and J. New. Potential Economic Impact of Foot-and-Mouth Disease in the U.S. USDA, APHIS, 1979.

State of Alabama. *Alabama Statistics*. Montgomery, 1952-1982.

State of Alabama. *Census of Agriculture*. Montgomery, 1952-1982.

DEGRADATION OF INDIVIDUAL MYOFIBRILLAR PROTEINS
IN DYSTROPHIC CHICK SKELETAL MUSCLE
CELLS IN CULTURE[1]

Adriel D. Johnson and Ronald B Young
Department of Biological Sciences
University of Alabama in Huntsville
Huntsville, Alabama 35899

ABSTRACT

Degradation rates of six polypeptide components of the myofibril were examined in normal and dystrophic muscle cell cultures. Cell cultures were prepared from the pectoralis muscle of thirteen-day chick embryos. Degradation rates of selected polypeptide subunits were determined by dual labeling with [^{3}H]leucine and [^{14}C]leucine, and the myofibrillar fraction was then extracted and resolved into individual peptides by two-dimensional gel electrophoresis. Following the location of labeled peptides by fluorography and quantification of radioactivity by liquid scintillation spectrometry, the ratio of [^{3}H]/[^{14}C] in six prominent peptide spots was calculated. Stimulation of breakdown rates of these myofibrillar protein subunits in dystrophic muscle cells varied from approximately 0% to near 100%. These data indicate that faster myofibrillar protein degradation in genetic muscular dystrophy is not a generalized phenomenon and that some proteins are affected more severely than others. The fact that degradation varies among different proteins emphasizes that inaccurate conclusions may result from studying heterogeneous mixtures of proteins rather than specific peptides.

INTRODUCTION

Genetic muscular dystrophy in line 307 chickens results in muscle weakness, atrophy, fatty infiltration and other histopathological similarities to human muscular dystrophy (1,2). Myosin composes approximately one half of the myofibril, and the rate of myosin degradation is accelerated substantially in muscle cell cultures prepared from the embryos of line 307 dystrophic chicks (3,4). The other half of the myofibril is composed of 6-8 contractile proteins other than myosin, but virtually nothing is known about degradation rates of these other major proteins during muscular dystrophy. The goal of the present experiments was to analyze the degradation rates of individual myofibrillar proteins using dual isotope labeling techniques and two-dimensional polyacrylamide gel electrophoresis. The results show that the degradation rates of individual myofibrillar peptides vary widely with most being elevated 20-100% in dystrophic cells.

MATERIALS AND METHODS

Experiments were carried out on muscle cell cultures prepared from the breast muscle of normal (white leghorn) and dystrophic (line 307) chickens (3). Fertilized eggs from line 307 chickens were obtained from the Department of Avian Sciences, University of California, Davis. Fertilized white leghorn eggs used as controls were obtained from Feather Crest Hatchery, Arkadelphia, AL. Primary cultures of skeletal muscle were prepared from embryonic breast muscle of 13-day embryos and were cultured in 85% Eagle's minimum essential medium containing 10% horse serum, 5% chick embryo extract, 50 units/ml penicillin, 50 µg/ml streptomycin, 2.5 µg/ml fungizone and 85 µg/ml gentamycin. Culture medium was changed every 24 hr, and the cells were incubated at 37°C in a 5% CO_2 atmosphere. When muscle cell proliferation began to decline (day 3 of culture), 10^{-6} M fluorodeoxyuridine was added to the culture medium to inhibit fibroblast proliferation. Cultures were studied after 6-8 days by which time the cells were at steady state with respect to myofibrillar protein synthesis and degradation (3,5).

Dual labeling of proteins with [^{3}H]leucine (20 µCi/ml) and [^{14}C]leucine (1 µCi/ml), followed by two dimensional gel electrophoresis, was used to assess synthesis rates. Crucial for the experiments was the addition of a constant quantity of cell homogenate from [^{14}C]leucine-labeled normal cells to homogenates derived from equal numbers of cells in [^{3}H]leucine-labeled normal and [^{3}H]leucine-labeled dystrophic cultures. Following purification and electrophoretic analysis of individual components of the myofibrillar fraction (4), the [^{3}H]/[^{14}C] ratio for certain peptides from normal and dystrophic cultures was determined. If the rate of synthesis (and therefore the breakdown rate since the cells are at steady state) of the peptide in question is equal in normal and dystrophic cells, this ratio should be equal for the two cell types. However, if the breakdown rate of a particular myofibrillar polypeptide is elevated in dystrophic cells, the [^{3}H]/[^{14}C] ratio in the [^{3}H]-Dystrophic/[^{14}C]-Normal mixture would be higher than the [^{3}H]/[^{14}C] ratio in the [^{3}H]-Normal/[^{14}C]-Normal mixture by an amount that is directly proportional to the difference in degradation rate. Thus, the [^{14}C]-labeled homogenate served as an internal standard to which normal and dystrophic cells could be compared. Additionally, the quantity of [^{3}H]leucine in the dystrophic cells was corrected by a factor corresponding to the difference in the ratio of the leucyl-tRNA specific radioactivities between normal and dystrophic cells (6). This latter correction was necessitated by the fact that the leucyl-tRNA specific radioactivity in dystrophic cells less than the leucyl-tRNA specific radioactivity in normal cells (6). Once samples had been isolated (4), isoelectically focused (7), separated by electrophoresis on polyacrylamide slab gels in the presence of sodium dodecyl sulfate (7), fluorographed (to aid in location of individual spots), excised from the dried gel and analyzed to liquid scintillation spectrometry (8), the ratios of [^{3}H]/[^{14}C] were tabulated and compared.

RESULTS AND DISCUSSION

Table I gives results for six peptides that co-precipitate with the myofibrillar fraction. The pattern of proteins from normal and dystrophic

cells was qualitatively identical on two-dimensional gels (Figure 1), but comparison of the $[^3H]/[^{14}C]$ ratios between normal and dystrophic cells revealed a consistently higher $[^3H]/[^{14}C]$ ratio in the dystrophic cells (Table 1). Stimulation of synthesis in dystrophic cells ranged from approximately 12% to near 100% (Table 1). It was also possible to analyze myosin heavy chain for comparison with previously published data (3,4). In this case, it should be made clear that myosin heavy chain did not isoelectrically focus in the first dimension; however, it did migrate as a single band for a short distance into the isoelectric focusing gel (myosin heavy chain is too large to focus under the specific conditions used). It is clear that the increase found for myosin heavy chain is virtually the same as that reported using other techniques (3,4). This observation lends credibility to the accuracy of the dual labeling technique. Thus, the faster breakdown of individual components of the myofibril in dystrophic cells varies considerably.

Table 1. Comparison of $[^3H]/[^{14}C]$ ratios in selected myofibrillar components in normal and dystrophic cells following pulse labeling for 4 hr.

Molecular Weight	pI	Normal $[^3H]/[^{14}C]$	Dystrophic $[^3H]/[^{14}C]$	% Stimulation In Dystrophic
200,000 (myosin heavy chain)		21.5 ± 2.0	31.3 ± 2.3	45.6
46,800	5.67	26.3 ± 2.6	39.5 ± 3.3	50.2
42,700	4.86	26.6 ± 2.1	51.4 ± 4.1	93.2
33,000	5.55	14.1 ± 0.8	31.8 ± 3.2	125.5
23,400	5.27	23.6 ± 2.7	47.7 ± 8.9	102.1
136,500	6.04	14.8 ± 1.0	16.6 ± 1.8	12.2

Myofibrillar fractions were separated by two-dimensional gel electrophoresis. Each value is the mean ± SEM of a least five experiments with replicate samples in each experiment. Since experiments were carried out on steady-state cultures, the synthesis rate of each peptide is assumed to equal the degradation rate.

In contrast to difference between normal and line 307 cells reported here, negligible differences in protein synthesis and degradation in muscle cells from line 412 normal and line 413 dystrophic cell cultures have been reported (9). Line 412 is a better genetic control for line 413 than the white leghorn is for line 307 dystrophic chickens, and some of the differences likely reflect genetic divergence that is unrelated to the dystrophic lesion. Nevertheless, discovery of the mechanism by which myofibrillar protein synthesis and degradation are elevated so drastically in
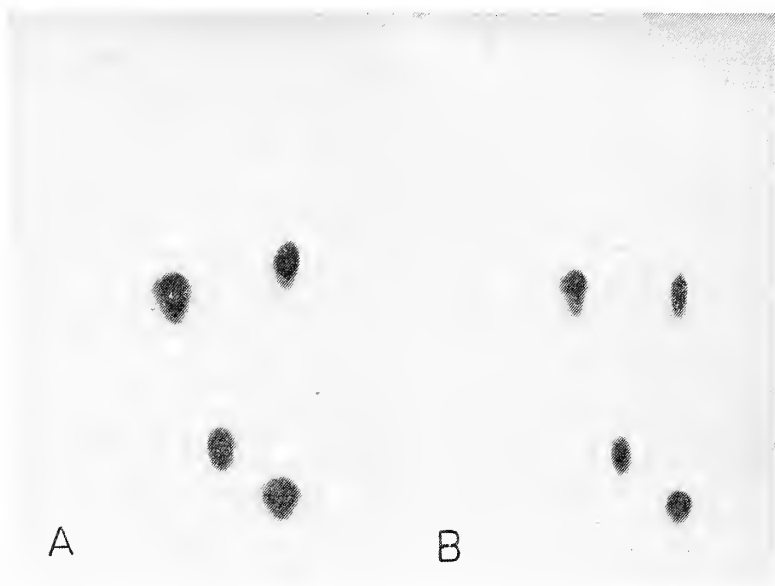
Figure 1. Fluorographs of two-dimensional electrophoretic separation of the major proteins in the myofibrillar fraction for Normal (A) and Dystrophic (B) muscle cell cultures. The molecular weight of each polypeptide was estimated from a series of radioactively labeled molecular weight markers that were co-electrophoresed at each end of the slab gel (not shown).

line 307 cells should provide insight into the mechanisms by which myofibrillar protein metabolism can be altered in muscle diseases or muscle atrophy. The fact that degradation varies among different myofibrillar peptides also emphasizes that inaccurate conclusions may result from studying heterogeneous mixtures of myofibrillar proteins rather than specific peptides. Evidence for abnormalities in the proteolytic systems that metabolize myofibrillar proteins in dystrophic cells is reasonably convincing (3,4,6); however, it is not known if faster breakdown in dystrophic cells is due to a proportionally increased concentration of specific proteases, or to accelerated enzyme activity. In any event, accelerated myofibrillar protein degradation, one of the primary manifestations of line 307 genetic muscular dystrophy, seems to be expressed in muscle cells in culture.

LITERATURE CITED

1. McMurtry, S. L., Kulian, L. M. and Asmundson, U. S.: Hereditary muscular dystrophy of the chicken. *Arch. Pathol.* 94, 217-224 (1972).

2. Wilson, B. W., Randall, W. R., Patterson, G. T. and Entrikin, R. K.:
    Major physiologic and histochemical characteristics of inherited
    dystrophy of the chicken. *Ann. N.Y. Acad. Sci.* 317, 224-246 (1979).

3. Young, R. B., McConnell, D. G., Suelter, C. H. and Phillips, T. A.:
    Normal and dystrophic embryonic chicken pectoralis muscle cultures:
    I. Cell differentiation, protein synthesis, and enzyme levels. *Mus-
    cle Nerve* 4, 117-124 (1981).

4. Riebow, J. F. and Young, R. B.: Effect of Leupeptin on protein turn-
    over in normal and dystrophic chicken skeletal muscle cells in cul-
    ture. *Biochem. Med.* 23, 316-323 (1980).

5. Young, R. B. and Dombroske, O. C.: Metabolism of myosin heavy chain
    in steady-state chick skeletal muscle cultures. *Biochem. J.* 194,
    241-247 (1981).

6. Schneible, P. A. and Young, R. B.: Leucine pools in normal and dys-
    trophic chicken skeletal muscle cells in culture. *J. Biol. Chem.*
    259, 1436-1440 (1984).

7. O'Farrell, P. H.: High resolution two-dimensional electrophoresis of
    proteins. *J. Biol. Chem.* 250, 4007-4021 (1975).

8. Young, R. B., Orcutt, M. W. and Blauwiekel, P. B.: Quantitative mea-
    surement of protein mass and radioactivity in N,N'-diallyltartardi-
    amide crosslinked polyacrylamide slab gels. *Anal. Biochem.* 107,
    202-206 (1980).

9. Wolitsky, B. A., Segal, H. L. and Hudecki, M. S.: Similarities in
    protein synthesis and degradation in normal and dystrophic muscle
    cultures. *Exptl. Cell Res.* 137, 295-299 (1982).

TERATOGENESIS OF RETINOIC ACID IN TWO[1]
STRAINS OF MICE

Anne M. Cusic and C. P. Dagg
Department of Biology
University of Alabama in Birmingham
Birmingham, Alabama 35294

ABSTRACT

Four doses of all-trans retinoic acid were administered on day 9, 10, or 11 to pregnant females of a partially inbred strain of mice, ICR. facial dermal tabs, anal atresia, eye and external ear defects, and urogenital anomalies were produced in the embryos after dosing on day 9. Limb defects were induced on both day 10 and 11. Cleft palate and tail malformations were found on all three days. Palate, tail, and limb malformations tended to show a rectilinear dose-response relationship. A single dose of retinoic acid was administered to an inbred strain of mice, C57B1/10, on either day 9, 10, or 11 for comparison with the ICR. Differences in sensitivity of certain target tissues were observed between the two strains. When reciprocal crosses between the two strains were tested for differences in response to retinoic acid, it was found that teratogenetic effects were influenced both by maternal and embryonal genes and that the mode of inheritance of susceptibility appeared to be dissimiliar for malformations of the tail, palate, and limbs.

INTRODUCTION

Retinoic acid has been reported to be teratogenic in mice and rats (Kochhar, 1967), hamsters (Shenefelt, 1972), and primates (Fantel *et al.*, 1977). Recently 13-cis retinoic acid, which has been used medically for the treatment of acne, has been reported to be teratogenic in humans (FDA, 1983). Many of the malformations produced by retinoic acid are stage dependent, that is: influenced by the time during gestation when the compound is administered (Kochhar, 1967; Shenefelt, 1972). Kalter (1983) has examined the effect of retinoic acid on noninbred mutant mouse strains and has reported that even noninbred lines of mice can be variable in their response to this drug.

The following study was designed to examine the effect of retinoic acid on different gestational days and at various dosages in a partially inbred line of ICR mice. A highly inbred line, C57B1/10, was administered a single dose of retinoic acid on various days of gestation in order to compare the production of malformations between the two strains. To examine the inheritance of susceptibility or resistance to retinoic acid, reciprocal crosses between the two strains were made.

MATERIALS AND METHODS

Two strains of mice were used in this study: the ICR, a partially inbred strain, originally obtained from Southern Animal Farms, and the C57B1/10Dg (B/10), a highly inbred strain. Intrastrain matings and reciprocal crosses between strains were made. The mice were maintained on a 12-hour-light and 12-hour-dark cycle in a temperature-regulated room. Animals were fed commercial laboratory chow and water *ad libitum*. Nulliparous females, eight weeks of age or older, were housed with males overnight, and the date of the vaginal plug was designated day 0 of gestation.

All-trans retinoic acid (RA) was prepared in a mixture of 10% propylene glycol and 8% Cremophor EL® in distilled water by the method described by Hixson and Denine (1978). All compounds were obtained from Sigma Chemical Company.

Pregnant females of the ICR strain were dosed orally with either 200, 100, 50, or 25 mg/kg of RA on either day 9, 10, or 11 of gestation. B/10 females were given 100 mg/kg of RA orally on either day 9, 10, or 11 of gestation. In the reciprocal crosses, females were given 100 mg/kg of RA, orally, only on day 10 of gestation. In each strain, a group of females served as a diluent control and was administered an equal volume per weight (.05 ml per 10 grams body weight) of the RA diluent on either day 9, 10, or 11. An untreated control group was used for comparison.

Females in all groups were sacrificed on day 18 of gestation by cervical dislocation. Fetuses and placentas were removed and weighed separately. Live fetuses were examined for gross malformations. Randomly selected fetuses from each group, dosage level, and day of treatment were stained by the alizarin red S method for the detection of skeletal malformations. Hybrid fetuses were not examined for skeletal malformations. Statistical analyses of gross malformations and dead and resorbed fetuses were performed by a method based on t-tests of arcsin square root transformed frequencies (Sokal and Rohlf, 1969). Fetal and placental weights were analyzed by the Student's t-test.

RESULTS

RA treatment on day 9

When RA was administered to pregnant ICR's at various dosages on day 9, all doses produced gross defects (Table 1). However, at 25 mg/kg, only cleft palate was increased over the untreated control values. This value was higher than at the 50 mg/kg dose but was not significantly different from it. Cleft palate, anal atresia, dermal tabs, malformed tails and urogenital malformations were significantly elevated over the untreated control values at 50, 100, and 200 mg/kg. Eye and ear malformations were produced only with the two highest dosages. Therefore, different structures varied in their threshold of sensitivity to RA. There was no significant difference in either fetal or placental weights with any dose of RA. Dead and resorbed fetuses were increased only with the 25 mg/kg dosage. No explanation for this decrease was apparent. The diluent did not induce malformations.

When RA was administered on day 9 to the inbred B/10s, the same types of defects observed in the ICR strain were produced. All defects were

Table 1. Major Effects of all-trans retinoic acid administered on day 9 of gestation to ICR and C57Bl/10 mice. The fetuses were examined on day 18.

	ICR						C57Bl/10	
	200 mg/kg	100 mg/kg	50 mg/kg	25 mg/kg	DILUENT CONTROLS	UNTREATED CONTROLS	100 mg/kg	UNTREATED CONTROLS
Live Fetuses, no.	120	223	124	88	133	411	50	128
Litters, no.	10	21	11	10	14	37	10	15
Dead and resorbed, %	10.9	17.4	13.3	27.9[a]	17.4	15.0	21.9	14.4
Cleft palate, %	80.0[a]	61.0[a]	9.7[a]	17.0[a]	0.0	0.0	20.0[a] [b]	0.0
Anal atresia, %	91.7[a]	65.5[a]	5.6[a]	0.0	0.0	0.5	68.0[a]	0.0
Dermal tabs, %	51.7[a]	50.7[a]	6.5[a]	0.0	0.0	0.0	56.0[a]	0.0
Tail defects, %	100.0[a]	93.3[a]	19.4[a]	2.2	0.7	1.5	98.0[a]	0.0
Urogenital defects, %	45.8[a]	39.9[a]	12.9[a]	4.5	0.7	1.9	32.0[a]	0.0
Open eyes, %	8.3[a]	2.2	0.0	1.1	0.0	0.7	22.0[a] [b]	0.8
Malformed external ears, %	24.2[a]	11.7[a]	0.0	0.0	0.0	0.0	30.0[a] [b]	0.0

[a] Significantly different from untreated controls of same strain at p<.01.
[b] Significantly different from ICR fetuses at 100 mg/kg at p<.01.
[c] The diluent-control B/10 mice were dosed on either day 9, 10, or 11 of gestation. See MATERIALS AND METHODS and RESULTS sections.

significantly more frequent than in the untreated controls (Table 1).
Both strains responded in a similar manner in relation to anal atresia,
dermal tabs, urogenital defects, and malformed tails. Eye and ear mal-
formations were more prevalent, and cleft palate was less so in the B/10
mice. Fetal weights were not affected, however, placental weights were
larger in the RA-treated group than in the untreated controls (0.122 g vs
0.107 g, respectively). The B/10 females were limited in number and
therefore the diluent was administered to only four females on day 9 or 10
and five animals on day 11. No significant gross defects were observed in
these 13 litters nor were there differences in fetal or placental weights
when compared to the untreated controls.

Alizarin staining of ICR fetuses showed malformed thoracic, lumbar,
sacral, and caudal vertebrae. The principle defects were missing, fused
or abnormally shaped centra, and neural arches. In the ICR strain, normal
fetuses were observed only at the 25 and 50 mg/kg doses, with more occur-
ring at the lower dose. The incidence of thoracic defects showed no dose-
response relationship, but the rates of lumbar and sacral defects did ap-
pear to be dose related. All doses of RA increased the production of ex-
tra ribs (13th) over the level in the untreated controls.

When the ICR group treated with 100 mg/kg of RA was compared to the
B/10 fetuses exposed to the same dose, lumbar and sacral defects were
higher in the B/10s, but caudal and thoracic defects were similar in fre-
quency. No extra rib formation was induced by RA in the B/10 strain.

RA treatment on day 10

When ICR females were administered various dosages of RA on day 10 of
gestation, all doses produced an increase in gross defects (Table 2).
Forelimb defects, which consisted of short and/or bent limbs, and forelimb
digital defects, which consisted of missing and/or fused digits on the
preaxial side, were induced with all doses. Short and/or kinked tails
were also increased over the untreated control values with all doses of
RA. Significant increases were observed in short and/or bent hind limbs
and in missing and/or fused hind limb digits only at the 200 and 100 mg/kg
dosages. No significant difference was found at any dosage level in fetal
or placental weights. Dead and resorbed fetuses were increased only with
the 200 mg/kg dosage. The diluent did not influence growth or develop-
ment.

When RA was administered to B/10 females, the major defects which
were produced in ICR fetuses were observed, except no hind limb or paw
defects were produced in the B/10 fetuses (Table 2). In all types of
defects, the B/10 strain was significantly lower than the ICR strain with
the exception of malformed tails which were increased over ICR values.
Dead and resorbed fetuses were increased in the B/10 strain, although not
in the ICR. Fetal and placental weights were not affected by RA in the
B/10 mice.

The major skeletal defects produced by RA in either the ICR or B/10
strains were similar. They included reduced and/or thickened scapulae and
humeri; reduced, thickened or bent radii and ulnae; missing metacarpi; and
missing caudal centra or vertebrae. The ICR fetuses also had illial or
ishial defects, as well as shortened femora, tibiae, and fibulae. Defects
were most severe with the highest dose. The low doses (50 and 25 mg/kg)

Cusic and Dagg

Table 2. Major effects of all-trans retinoic acid administered on day 10 of gestation to ICR and C57Bl/10 mice. The fetuses were examined on day 18.

| | ICR | | | | | C57Bl/10 |
	200 mg/kg	100 mg/kg	50 mg/kg	25 mg/kg	DILUENT CONTROLS	100 mg/kg
Live Fetuses, no.	70	202	124	114	166	126
Litters, no.	10	20	11	10	15	19
Dead and resorbed, %	36.9^a	16.9	11.4	13.0	9.8	37.0^{ab}
Cleft palate, %	85.7^a	61.4^a	32.3^a	1.6	0.6	37.3^{ab}
Malformed forelimbs, %	75.7^a	76.2a	50.0^a	16.7^a	0.0	30.2^{ab}
Forelimb digital defects, %	80.0^a	70.3^a	41.1^a	7.0^a	0.0	30.2^{ab}
Malformed hind limbs, %	24.3^a	18.8^a	0.0	0.9	0.6	0.0^b
Hind limb digital defects, %	25.7^a	3.5^a	2.4	0.0	0.0	0.0^b
Tail defects, %	100.0^a	65.3^a	35.5^a	9.6^a	0.6	89.7^{ab}

[a] Significantly different from untreated controls of the same strain at p<.01. See Table 1 for untreated controls.
[b] Significantly different from ICR fetuses at 100 mg/kg at p<.01.
[c] For diluent controls for C57Bl/10 mice see Table 1.

produced a higher percentage of normal fetuses (44.1% at 25 mg/kg vs 4.3% at 200 mg/kg). No hind limb skeletal malformations were observed with the 25 mg/kg dose. Long bone deformities in the ICRs were more frequent with skeletal analysis than was observed with gross observation, since slightly reduced or thickened bones could not be detected by gross examination.

As in the ICR strain, more limb defects were found in the B/10s after skeletal analysis than were observed by gross inspection. The forelimb long bones were more severely affected in the ICR fetuses than in the B/10s. No hind limb or pelvic skeletal defects were produced in the B/10 fetuses. Digital forepaw skeletal defects were lower in the B/10 than in the ICR fetuses. Normal fetuses found at 100 mg/kg were similar in frequency in each strain (3.2% in the ICR vs 2.6% in the B/10).

RA treatment on day 11

The administration of RA on day 11 to ICR mice resulted in the production of gross defects at all doses (Table 3). The frequency of cleft palate, forelimb and hind limb defects, and hind paw digital defects were numerically increased at all doses when compared to day 10 values. Tail malformations decreased when compared to day 10 levels. The malformations of the tail on day 11 were greater than control levels only at the two highest doses. The type of tail defects differed from day 10 treatment in that tails were not as short. Fetal weight was decreased only with the 100 mg/kg dose of RA (1.19 g vs 1.27 g, respectively). Placental weights were not affected by any dosage of RA. Dead and resorbed fetuses were increased significantly only at the 200 mg/kg level. The administration of the diluent on day 11 did not produce any defects in frequencies greater than found in the untreated controls.

Table 3. Major effects of all-trans retinoic acid administered on day 11 of gestation to ICR and C57Bl/10 mice. The fetuses were examined on day 18.

	ICR					C57Bl/10
	200 mg/kg	100 mg/kg	50 mg/kg	25 mg/kg	DILUENT CONTROLS	100 mg/kg[c]
Live Fetuses, no.	98	190	115	121	120	71
Litters, no.	11	20	10	10	10	10
Dead and resorbed, %	30.5[a]	21.2	15.4	15.4	11.8	16.5
Cleft palate, %	98.0[a]	99.5[a]	46.1[a]	28.1[a]	0.0	83.1[ab]
Malformed forelimbs, %	94.9[a]	95.8[a]	68.7[a]	20.7[a]	0.0	94.4[a]
Forelimb digital defects, %	59.2[a]	69.5[a]	16.5[a]	5.0[a]	0.0	90.1[ab]
Malformed hind limbs, %	100.0[a]	99.5[a]	93.9[a]	89.3[a]	1.7	98.6[a]
Hind limb digital defects, %	99.0[a]	97.9[a]	71.3[a]	39.7[a]	0.0	97.2[a]
Tail defects, %	67.3[a]	24.7[a]	6.1	0.0	0.0	46.5[ab]

[a] Significantly different from untreated controls of the same strain at p<.01. See Table 1 for untreated controls.
[b] Significantly different from ICR fetuses at 100 mg/kg at p<.01.
[c] For diluent controls for C57Bl/10 mice see Table 1.

When the two strains were compared for response to 100 mg/kg of RA on day 11, they reacted similarly in the production of gross defects, more so than at any other treatment day (Table 3). Cleft palate was significantly lower in the B/10 strain than in the ICR, however both strains were more sensitive on this day than on day 10. Forelimb digital defects and malformed tails were significantly higher in the B/10s. Dead and resorbed fetuses and fetal weights were not different from the untreated controls. Placental weights were increased in the B/10 strain (0.122 g vs 0.107 g).

All doses of RA administered on day 11 to ICR mice caused skeletal defects in all fetuses examined. The major defects were shortened or missing humeri, radii, ulnae, femora, and tibiae. Shortened or abnormal scapulae were also produced in fetuses from each dosage group. Abnormal cervical vertebrae, ishia, and extra ribs were also found. The three highest doses induced long bone malformations in 90% or more of the fetuses.

In comparing the 100 mg/kg dosage in the two strains, the same types of malformations were produced. Long bone defects in fore-and hind limbs were above 90% in the B/10 strain. Scapular defects were produced in a high percentage in the B/10 mice but the value was somewhat lower than in the ICRs. Shortened ishia were fewer in the B/10s (41.5% vs 2.3%), as were cervical vertebral defects (79.2% vs 2.3%). No normal fetuses were observed.

RA in reciprocal crosses

When 100 mg/kg of RA was administered on day 10 to reciprocal crosses between the ICR and the B/10 strains, the same types of gross defects were produced as in the parental strains, but differences in frequencies of defects were observed, dependent upon the strain of the female (Table 4). Fetuses from RA-treated ICR females mated with B/10 males differed from ICR X ICR fetuses in decreased levels of cleft palate and malformed hind limbs. However, malformed tails were higher in the hybrids. RA-treated B/10 females mated with ICR males produced fetuses with increased values of malformed forelimbs and hind limbs, and forelimb and hind limb digital defects when compared to B/10 fetuses. When the F_1 fetuses from reciprocal crosses were compared with each other, the frequencies of limb defects of all kinds were different, and in every case, the level was higher when the mother was a B/10. Fetal weights were increased in the hybrid fetuses from B/10 females when compared to pure B/10 fetuses, but no difference in fetal weight was detected between the hybrid fetuses from ICR females when compared to treated pure ICR fetuses.

DISCUSSION

Retinoic acid (RA) is unlike vitamin A or retinol in that it is rapidly excreted or degraded (DeLuca and Roberts, 1969). RA or its metabolites reached peak levels in the embryo within twelve hours after administration to pregnant mice (Kochhar, 1976). *In vitro* studies showed the same types of limb malformations as those observed from *in vivo* studies (Kochhar and Aydelotte, 1974). This study, like those of other investigators (Kochhar, 1973; Shenefelt, 1972), showed a relatively precise stage-dependency for the induction of specific malformations by RA. The major

Table 4. Major effects of 100 mg/kg of all-trans retinoic acid adminis-
tered on day 10 of gestation to reciprocal crosses between ICR
and C57B1/10 mice.

	ICR Females X C57B1/10 Males	C57B1/10 Females X ICR Males
Live Fetuses, no.	100	73
Litters, no.	11	13
Dead and resorbed, %	17.4	25.6[b]
Cleft palate, %	45.0[a]	52.1
Malformed forelimbs, %	72.0	94.5[b c]
Forelimb digital defects, %	59.0	93.2[b c]
Malformed hind limbs, %	8.0[a]	47.9[b c]
Hind limb digital defects, %	11.0	35.6[b c]
Tail defects, %	100.0[a]	97.3

[a] Significantly different from ICR X ICR at p<.01. See Table 2.
[b] Significantly different from C57B1/10 X C57B1/10 at p<.01. See Table 2.
[c] Significantly different from ICR female X C57B1/10 at p<.01.

defects produced by RA on day 9, 10, or 11 were in agreement with those
reported in other strains of inbred and noninbred mice (Kochhar, 1967,
1973; Khemmani, 1973; Kwasigroch and Kochhar, 1980).

Some malformations were seen in high percentages only after treatment
on day 9, e.g., anal atresia, facial dermal tabs, eye and external ear
defects, and urogenital anomalies. Limb defects were induced on both day
10 and 11. Cleft palate and tail malformations were found on all three
days.

Cleft palate was produced in both strains on all three days, with day
11 being most sensitive. When dose was plotted against frequency of cleft
palate, all of the points for day 9 treatment did not fall on a straight
line (Figure 1). The values for 25, 100 and 200 mg/kg fell on a straight
line as shown, but in this case, the result for 50 mg/kg was too low. On
the other hand, if a line were drawn for the three highest doses, it would
roughly parallel the slopes for day 10 and 11, but the result for the 25
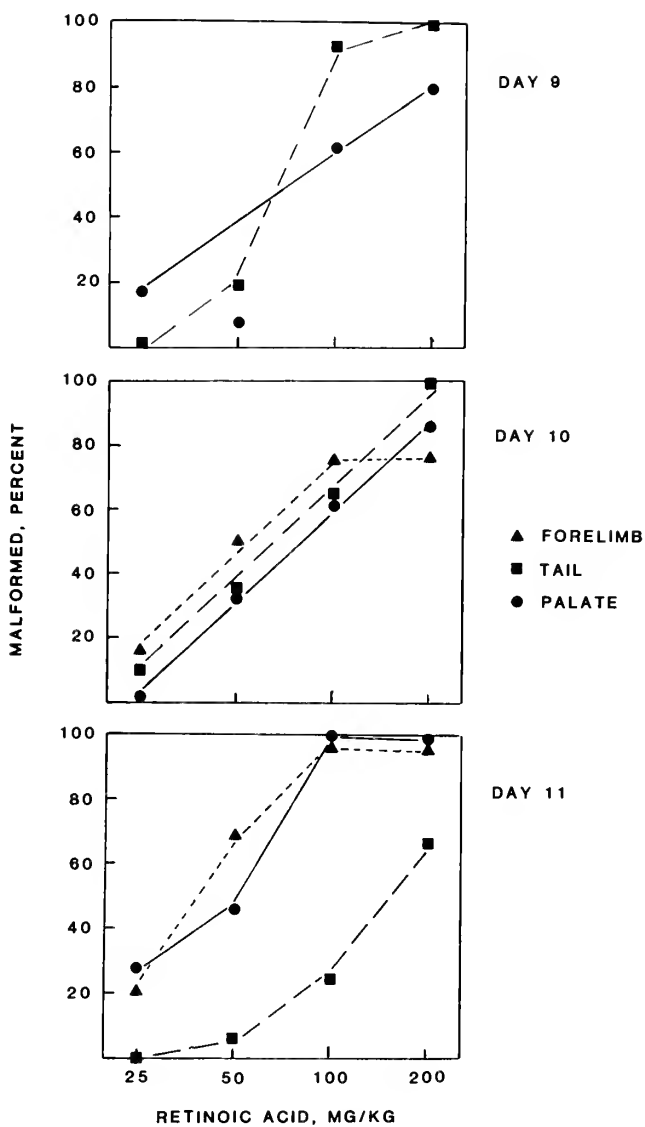
Figure 1. Dose-response relationships for fetal malformations produced by the administration of all-trans retinoic acid on day 9, 10, or 11 of gestation to pregnant ICR mice.

mg/kg dose would have been too high. On day 10 there was a well-defined rectilinear dose-response relationship. On day 11 the frequencies of cleft palate were progressively higher as doses were increased from 25 to 50 to 100 mg/kg. Although their relationship was not as precisely rectilinear as on day 10, the data indicate that the population of embryos shifted, more or less uniformly, toward greater sensitivity.

For tail malformations, after day 9 treatment, there was a sharp increase in slope between the 50 and 100 mg/kg doses, with all fetuses being affected at 200 mg/kg. For tail malformations produced on day 10, the points fell close to a straight line, but the slope was not as steep as observed on day 9. On day 11, a line can be drawn for the three highest doses which would parallel the slope for day 10, and would show a uniform decrease in sensitivity to the induction of tail defects. Thus, during development from day 10 to 11, the tails decreased in sensitivity, whereas the palates became more sensitive.

No limb defects were observed after day 9 administration of RA. On day 10, forelimb defects increased rectilinearly from 25 to 100 mg/kg, but no further increase was found with 200 mg/kg. Plateaued response curves like this have been observed for hind limb defects in four strains of inbred mice dosed with chlorodeoxyuridine (Dagg *et al.*, 1964). These results can be interpreted as showing that on a given day of treatment, only a limited proportion of the population of target organs, e.g., forelimbs, were at the critical stage for deformation by the teratogen. Accordingly, in these studies, no forelimbs, could respond on day 9; a maximum of 75% could respond on day 10; and all were responsive on day 11.

To facilitate discussion of genetic differences between ICR and B/10 mice, data for the reciprocal crosses and the parental strains have been presented in graphic form (Figure 2). The target tissues showed three different patterns of responses which suggest different modes of inheritance of sensitivity; that is, different patterns were found for the tail, palate, and limbs.

The B/10 embryos displayed a greater sensitivity to the induction of tail defects than did the ICRs. The frequencies of tail defects in the two types of F_1 embryos were equal, and they were also equal to or greater than the level in inbred B/10s, suggesting that in these crosses there were dominant genetic factors for tail defects in the B/10 strain. For one other indicator of fetotoxicity, dead and resorbed embryos, the B/10s were more sensitive than the ICRs. After exposure to RA on day 10, but not the other days, significantly more dead and resorbed embryos were found in the treated group than in the untreated controls, 37.0% vs 14.4%. Embryolethality was unaffected in the ICRs. In this regard, it is important to emphasize that both strains received the same amount of RA when dose was based on maternal body weight, but that the B/10s received less when dosage is converted to absolute amounts, because the pregnant B/10 females weighed less than the ICRs, 30.0 g vs 36.8 g average body weight.

For cleft palate, the B/10 embryos were less sensitive than the ICRs, and the F_1 embryos gave responses that were similar to each other and were intermediate to the parental strains. The simplest interpretation for these results is that the genes involved in palatal defects were additive.

All appendicular anomalies fell into the same pattern of response, with a few significant departures (Figure 2). In general, the inbred B/10 embryos were less sensitive than the ICRs to the induction of appendicular
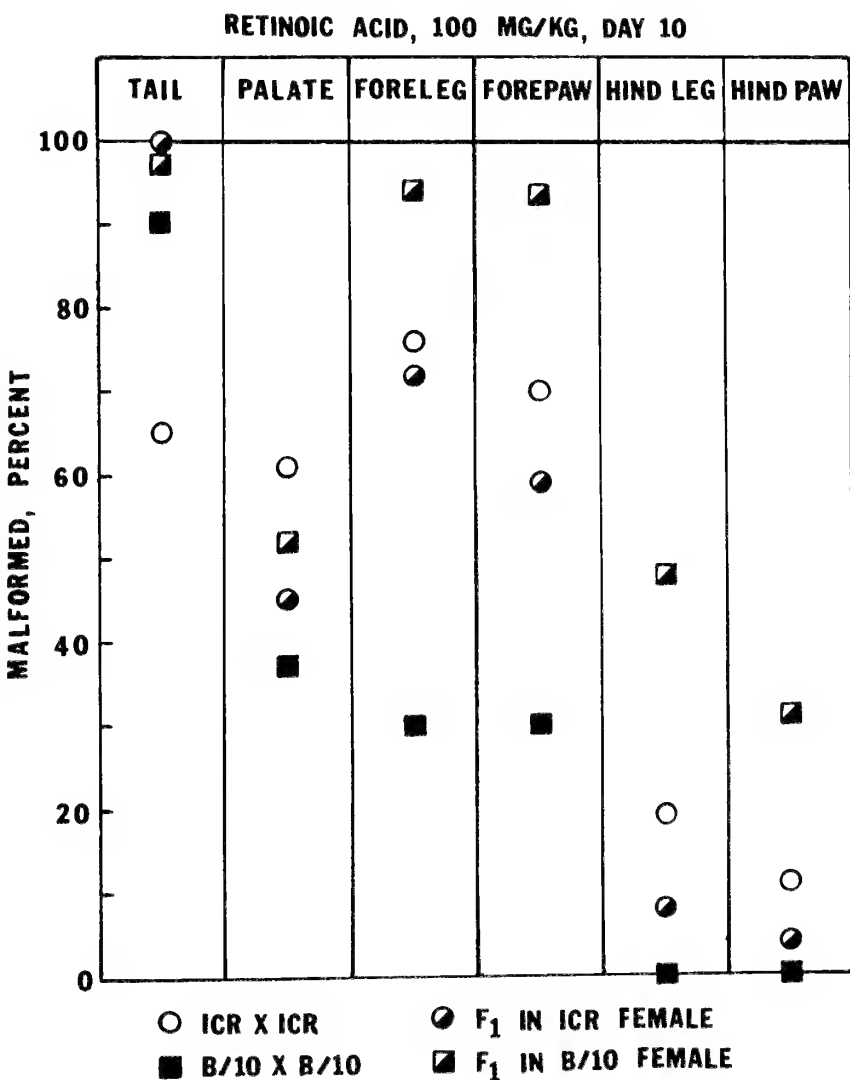
Figure 2. Frequencies of fetal malformations produced by the administration of all-trans retinoic acid on day 10 of gestation to embryos from intrastrain matings of ICR and C57Bi/10 mice and the reciprocal crosses.

defects of all kinds. In the crosses, B/10 X B/10 and B/10 X ICR, the mothers are genetically identical but the embryos are different. Since the frequencies of appendicular defects were different for the two crosses, the results support the conclusion that embryonal genes affected the level of response. With exception of the hind paw defects, this relationship does not hold for the crosses ICR X ICR and ICR X B/10. The two types of F_1 fetuses gave dissimilar levels of appendicular malformations, and in every case, the level of response was higher when the mother was a B/10. Since the two types of F_1 embryos were genetically identical, except for the source of the Y-chromosome, these data can be interpreted as showing that the difference in responses of the F_1 fetuses was partly due to genetic differences in the maternal organism. Furthermore, the maternal effect was patriclinous. More detailed studies involving other compounds and other strains of mice indicated that genetic differences between strains are usually multifactoral (Kalter, 1965; Dagg *et al.*, 1966; Biddle, 1975, 1977).

Somewhat similiar results with other teratogens (Goldstein *et al.*, 1963) have led to the hypothesis that teratogenic effects are influenced by genes operating both in the mother and in the embryo and that these genes have opposite effects, that is in one strain maternal genes tend to decrease sensitivity whereas embryonal genes increase sensitivity. Alternative genetic models based on these data are being considered.

These studies demonstrate that the responses of three target tissues, tail, palate, and limbs, to RA-induced teratogenicity are separable according to several distinct criteria. First the tissues vary in sensitivity on the same day. Second, the comparative sensitivity varies with the day of treatment. Third, the mode of inheritance involving both maternal and embryonal genes is different for each target tissue. It should be added that other experiments from this laboratory (Cusic and Dagg, submitted for publication) have demonstrated that indomethacin reduced tail malformations caused by RA but had no effect on cleft palate. Chloroquine, conversely, reduced the incidence of RA-induced cleft palates but had no effect on tail malformations.

LITERATURE CITED

Biddle, F. G. (1975) Teratogenesis of acetazolamide in the CBA/J and SWV strains of mice II. Genetic control of the teratogenic response. Teratology, 11:37-46.

Biddle, F. G. (1977) 6-aminonicotinamide-induced cleft palate in the mouse: the nature of the difference between the A/J and C57B1/6J strains in frequency of response and its genetic basis. Teratology, 16:301-312.

Dagg, C. P., H. Nishimura, M. L. Murphy and A. Doerr. (1964) Cited in Nishimura, H., Chemistry and Prevention of Congenital Anomalies. C. C. Thomas, New York, p. 64.

Dagg, C. P., G. Schlager, and A. Doerr. (1966) Polygenic control of the teratogenicity of 5-fluorouracil. Genetics, 53:1101-1117.

DeLuca, H. F., and A. B. Roberts. (1969) Pathways of retinoic acid and retinol metabolism. Am. J. Clin. Nutr., 22:945-952.

Fantel, A. G., T. H. Shepard, L. L. Newell-Morris, and B. C. Moffett. (1977) Teratogenic effects of retinoic acid in pigtail monkeys (*Macaca nemestrina*) I. General features. Teratology, 15:65-72.

FDA, (1983) Adverse effects with isotretinoin. FDA Drug Bulletin, 13: 21-23.

Golstein, M., M. F. Pinsky, and F. C. Fraser. (1963) Genetically determined organ specific responses to the teratogenic action of 6-aminonicotinamide in the mouse. Genet. Res. Camb., 4:258-265.

Hixson, E. J., and E. P. Denine. (1978) Comparative subacute toxicity of all-trans and 13-cis-retinoic acid in Swiss mice. Toxicol. Appl. Pharmacol. 44:29-40.

Kalter, H. (1965) Interplay of intrinsic and extrinsic factors. In Teratology: Principles and Techniques. Edited by J. G. Wilson and J. Warkany. University of Chicago Press, Chicago. pp. 57-80.

Kalter, H. (1983) Noninbred mutant mouse stocks differ in teratologic responsiveness to retinoic acid. Teratology, 27:54A.

Khemmani, M. (1973) The teratogenic effects of vitamin A acid in mice. Cong. Anom., 13:181.

Kochhar, D. M. (1967) Teratogenic activity of retinoic acid. Acta. Path. et Microbiol. Scandinav., 70:398-404.

Kochhar, D. M. (1973) Limb development in mouse embryos I. Analysis of teratogenic effects of retinoic acid. Teratology, 7:289-298.

Kochhar, D. M. and M. B. Aydelotte. (1974) Susceptible stages and abnormal morphogenesis in the developing mouse limb, analyzed in organ culture after transplacental exposure to vitamin A (retinoic acid). J. Embryol. Exp. Morph., 31:721-734.

Kochhar, D. M. (1976) Transplacental passage of label after administration of ^{3}H retinoic acid (vitamin A acid) to pregnant mice. Teratology, 14:53-64.

Kwasigroch, T. E. and D. M. Kochhar. (1980) Production of congenital limb defects with retinoic acid: Phenomenological evidence of progressive differentiation during limb morphogenesis. Anat. Embryol. 161:105-113.

Shenefelt, R. E. (1972) Morphogenesis of malformations in hamsters caused by retinoic acid: Relation to dose and stage at treatment. Teratology, 5:103-118.

Sokal, R. R. and F. J. Rohlf. (1969) Biometry, W. H. Freeman, San Francisco, pp. 607-608.

THE EFFECTS OF A SINGLE BOUT OF SUB-MAXIMAL
EXERCISE ON THE PSYCHO-PHYSIOLOGICAL
PARAMETERS OF ACUTELY INDUCED STRESS

Richard A. Clendaniel and Kennon T. Francis
School of Community and Allied Health
Division of Physical Therapy
The University of Alabama in Birmingham
Birmingham, Alabama 35294

ABSTRACT

The purpose of this study was to clarify the relationship between a single bout of sub-maximal exercise (15 minutes of pedaling a cycle at a heart rate of 120-150) and the changes in the psycho-physiological responses to an experimentally induced stress, delayed auditory feedback (DAF). Twenty male volunteers participated in each of the three experimental conditions: a) exercise, b) DAF and c) exercise plus DAF. The psychological parameters of state anxiety, depression, and hostility were measured with the Multiple Affect Adjective Check List during the five minute pre-test period and again during the five minute post-test period. Heart rate, blood pressure and EMG were measured during the five minute pre-test period as well as during the five minute "stress period".

A comparison of the changes in psychological parameters from pre-to post-test for the experimental conditions of exercise and exercise plus DAF revealed no significant difference in the stress response. Likewise, a similar comparison of the changes in the physiological parameters from pre-test to "stress period" for the experimental conditions of DAF and DAF plus exercise revealed no significant difference in the stress response.

The results of this study indicate that a single bout of exercise, prior to a stressful situation, neither alleviate nor potentiates the body's stress responses indicated by changes in the psychological parameters of anxiety, hostility and depression, and the physiological parameters of heart rate, blood pressure and EMG activity.

INTRODUCTION

There are a multitude of definitions which attempt to define or place in perspective the complex prodigy of "stress". The original studies of Selye (1,2) have contributed greatly to our understanding of the physiological and psychological concepts associated with this phenomenon. A more recent, revised definition of stress, which is an expansion of Selye's work and incorporates most of the current views of stress, has been offered by Vigas (3). He defines stress as the response of the organism to agents which actually or symbolically threaten its integrity. In addition, stress has been differentiated into acute, or "immediate stress" and chronic, or "prolonged stress". "Immediate Stress" can be defined as the condition of state anxiety, momentary feelings of apprehension and

tension, accompanied by autonomic nervous system arousal. "Chronic stress" can be defined as the condition of trait anxiety, habitual anxiousness, anxiety and hostility proneness (4).

The acute stress response is an inherent psychological and physiological process which allows one to cope with the increased demands of stressful situations. However, should the stress become chronic and unresolved, evidence suggests that the response pattern may lead to pathological changes within the body, specifically, coronary heart disease (5,6). The literature indicates that participation in a regular exercise program may be an effective method of behavior modification (7) for decreasing or countering the effects of acute stress (8,9). However, the literature is not clear regarding the effects of a single bout of exercise on the body's response to acute stress. Some of the available literature has indicated that there is a decrease in the psychological and physiological indicators of stress following a single bout of exercise, while other studies provide nonsupporting or inconclusive results (10-18). A search of the literature revealed no studies which attempted to investigate the relationship of the body's psychological and physiological response to induced acute stress following a single bout of exercise.

Therefore, the purpose of the present study was to clarify the effects of a single bout of exercise on the psychological and physiological indices of experimentally induced acute stress. The hypothesis was: a single bout of exercise, prior to an induced stressful situation (delayed auditory feedback), would decrease the body's psychological and physiological responses to that acute stressor.

METHODOLOGY

Subjects

Twenty male volunteers, ages 20-35, from the faculty, staff, and students of the University of Alabama in Birmingham (UAB) participated in this study. The permission to use human subjects was granted by the Institutional Review Board of UAB and informed consent was obtained from each subject.

Experimental Chronology

This study involved three sessions, each of approximately one hour duration. The experimental conditions consisted of either exercise, induced stress (DAF), or exercise followed by DAF (See Figure 1). The sequence of the three experimental conditions was randomized for each participant. The sessions were all conducted between the hours of 1:00 p.m. and 8:00 p.m.; each of the subjects' three sessions were conducted on three different days at approximately the same time each day. For each session, the subject was asked to not exercise that day prior to the session. Upon reporting to the laboratory, electrodes were attached, then the subject sat quietly for a five minute pre-test period. During the first minutes of this period, the subject completed the "today" form of the Multiple Affect Adjective Check List (MAACL).

The subject then proceeded through one of the three experimental conditions. Upon completion of the experimental session, the subject sat

FIGURE 1: TIME LINE OF EXPERIMENTAL CONDITIONS AND PARAMETERS MEASURED
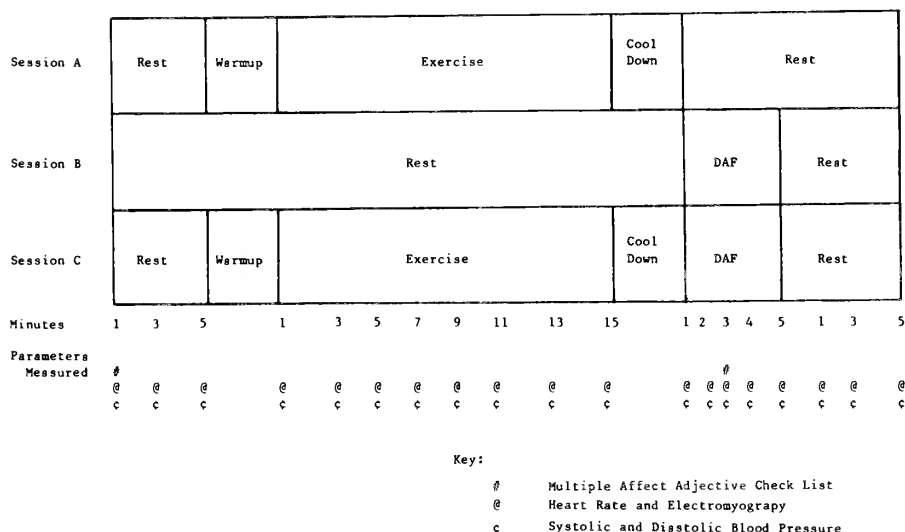
Figure 1. Time Line of Experimental Conditions and Parameters Measured.

quietly for a five minute post-test period and completed another copy of the "today form" of the MAACL.

Exercise Protocol

The exercise protocol consisted of pedaling a Monark Cycle Ergometer through a warm up phase, a 15 minute exercise period, and a cool down phase. The warm up required cycling at a rate of 15-20 kilometers per hour with a controlled, gradually increasing resistance, which elicited an "exercise heart rate" within the range of 120-150 beats per minute (bpm). Once the exercise heart range was attained, the subject pedaled at this resistance and cycling rate for 15 minutes. After completion of the 15 minute exercise period, the resistance and cycling rate were decreased. When the subject's heart rate decreased to a level below 100 bpm, cycling was stopped, and the subject rested in a comfortable, sitting position until heart rate fell to within 10 bpm of his resting rate.

Induced Stress

Delayed auditory feedback (DAF) was used as the non-invasive method of inducing stress. In this technique, the normal auditory feedback of speech is drowned and disturbed by a timed, delayed feedback; the speaker hears everything he has spoken after a delay of 0.1 seconds or more. The apparatus used to produce DAF is a simple dual head tape recorder. The

121

test subject speaks a standard text into the microphone. The spoken text is recorded on an endless loop of magnetic tape, which is forwarded to a second play-back head and the recorded speech is then transferred to the test subject via headphones. DAF has been shown to induce acute enhancement of sympathetic activity, which is rapidly reversible after termination of the stressful event (23). In the present study DAF was produced with a Realistic T-3000 tape deck. With a tape speed of 9.5 centimeters per second, the apparatus provided a delay of 0.17 seconds. The reading passage was selected from an issue of the *Reader's Digest*. The reading passage was the same for all subjects.

Physiological and Psychological Assessment

The physiological parameters monitored in this study were heart rate, systolic and diastolic blood pressure, and the electrical activity of the frontalis muscle. Heart rate and blood pressure was monitored with a Critikon 1165 Exercise Monitor, utilizing a CM5 exercise lead. Both parameters were measured during the first, third, and fifth minutes of the pre-test and post test period. (See Figure 1).

The average electrical activity of the frontalis muscle was monitored continuously by surface electromyography (EMG); this was accomplished using a Beckman R-611 dynograph and a Beckman 9852A direct/average EMG coupler. The frontalis muscle EMG was obtained at the same time intervals as the measurements of heart rate.

The "today" form of the Multiple Affect Adjective Check List (MAACL) was used to assess the subject's state levels of anxiety and hostility (19,20). These levels were measured at the beginning of both the five minute pre-test and five minute post-test periods. (See Figure 1). The MAACL provides a measure of state levels of anxiety, depression and hostility. In responding to the MAACL, the subject simply checks adjectives (e.g., tense, nervous, calm) to describe how he feels. The higher the scores, the higher the level of anxiety, hostility and depression.

ANALYSIS OF DATA

Changes in psychological and physiological measurements "within" each experimental condition (compared to pre-conditions) were evaluated by analysis of variance (ANOVA) with repeated measures (21,22). Post-hoc comparisons of means were provided by the Tukey test. Differences in the respective psychological and physiological values "between" the post-conditions of "induced stress" and "exercise plus induced stress" were determined by a one-way ANOVA.

RESULTS

Psychological Measures

Table 1 presents the mean (±SE) for the pre-test and post-test measures of state anxiety, hostility, and depression for the three experimental conditions: 1) exercise, 2) induced stress, and 3) exercise plus induced stress. The mean pre-test anxiety scores ranged from 6.0 to 6.7 MAACL units while post-test values ranged from 6.0 to 7.3 units. The

largest increase in anxiety units occurred following the condition of exercise plus induced stress. This difference was significantly different at the p<0.05 level.

Table 1. Mean (±SE) pre-test and post-test MAACL units of anxiety, depression, and hostility for the experimental condition of exercise, induced stress, and exercise plus induced stress §.

Condition	Anxiety	Depression	Hostility
Exercise			
Pre-Test	6.7±0.6	13.3±1.1	7.0±0.6
Post-Test	6.0±0.7	12.8±1.1	7.0±0.5
Induced Stress			
Pre-Test	6.4±0.8	12.4±1.2	7.5±0.8
Post-Test	7.2±0.9	12.5±1.1	8.1±0.7
Exercise plus Induced Stress			
Pre-Test	6.0±0.7	12.4±1.3	6.2±0.7
Post-Test	7.3±0.6*	13.2±1.2	8.2±0.6*

*Significantly different at the p<0.05 level with respective pre-test value.
§N = 20

The mean pre-test scores for depression ranged from 12.4 to 13.3. The mean post-test scores ranged for 12.5 to 13.2. Comparison of pre-test and post-test scores within each of the experimental conditions revealed no statistically significant differences.

The mean pre-test scores for hostility ranged from 6.2 to 7.5. The mean post-test scores ranged from 7.0 to 8.2. The largest differences (2.0 units) occurred with the condition of "exercise plus induced stress." This increase was statistically significant at the p<0.05 level.

Comparison of the respective post-test values of anxiety, hostility and depression of the "induced stress" experimental condition and the condition of "induced stress plus exercise" revealed no statistically significant differences.

Physiological Variables

Heart Rate

The mean (±SE) pre-test and "stress period" values of heart rate (bpm) for each experimental condition ("exercise," "induced stress," "exercise and induced stress") are presented in Table 2.

Table 2. Mean (±SE) pre-test and stress period values of the physiologi-
cal parameters for each experimental condition §.

Condition	Heart Rate (bpm)	SBP (mmHg)	DBP (mmHg)	EMG (uV)
Exercise				
Pre-Test	66.8±1.8	121.6±1.6	71.8±1.4	8.0±4.0
Stress Period	77.9±1.9*	122.5±1.7	72.8±1.7	22.0±9.0*
Induced Stress				
Pre-Test	70.9±2.5	120.8±2.2	71.1±1.8	2.0±2.0
Stress Period	74.2±3.1*	128.0±3.1*	78.7±2.0	209.0±34.0*
Exercise plus Induced Stress				
Pre-Test	67.0±1.9	122.8±2.0	72.1±2.4	4.0±3.0
Stress Period	82.5±2.1*	130.8±2.7*	81.4±2.7*	274.0±60.0*

*Significantly different at $p < 0.05$ level with respective pre-test value.
§N = 20

The mean pre-test values for heart rate were 66.8 bpm prior to the
"exercise" condition, 70.9 bpm before the "induced stress" condition, and
67.0 bpm prior to the "exercise and induced stress" condition. Heart
rates during the "stress period" following the condition of "exercise,"
the condition of "induced stress." and the condition of "exercise plus
induced stress" were 77.9 bpm, 74.2 bpm, and 82.5 bpm, respectively. The
comparison of the pre-test and stress period heart rates within experiment
conditions, indicated that the increases in each experimental condition
were statistically significant ($p < 0.05$).
    Comparison of the post-test heart rate values between the "induced
stress" condition and the "induced stress plus exercise" condition reveal-
ed no statistical significant differences.

Systolic Blood Pressure

The mean (±SE) pre-test and "stress period" measures of systolic
blood pressure (SBP), in millimeters of mercury (mmHg), for each experi-
mental condition ("exercise," "induced stress," and "exercise plus induced
stress") are presented in Table 2. The mean pre-test values of SBP were
121.6 mmHg prior to the "exercise" condition, 120.8 mmHg before the "indu-
ced stress" condition, and 122.8 mmHg prior to the "exercise plus induced
stress" condition. Following the "exercise" condition, the mean SBP was
122.5 mmHg. This increase of 0.9 mmHg from the mean pre-test value was
not statistically significant. However, the mean stress period SBP during
the "induced stress condition was 128.0, an increase of 7.2 mmHg over the
pre-test value ($p < 0.05$). The mean stress period SBP for the condition of
"exercise and induced stress" was 130.8 mmHg. This was an increase of 8.0
mmHg from the mean pre-test value ($p < 0.05$).

Comparison of the post-test SBP values between the "induced stress" condition and the "induced stress plus exercise" condition revealed no statistical significant differences.

Diastolic Blood Pressure

Table 2 presents the mean (±SE) pre-test and "stress period" values of diastolic blood pressure (DBP), in mmHg, for each experimental condition ("exercise," "induced stress," and "exercise plus induced stress"). The mean pre-test values for DBP were 71.8 mmHg prior to the "exercise" condition, 71.1 mmHg prior to the "induced stress" condition, and 72.1 mmHg prior to the condition of "exercise plus induced stress." The mean stress period measures of DBP for the experimental conditions of "exercise," "induced stress," and "exercise plus induced stress" were 72.8 mmHg, 78.7 mmHg, and 81.4 mmHg, respectively. The increase of 1.0 mmHg with the "exercise" condition was not statistically significant. However, the increases of 7.6 mmHg with the "induced stress" condition, and 9.3 mmHg with the "exercise and induced stress" condition were statistically significant ($p < 0.05$).

Comparison of the post-test DBP values between the "induced stress" condition and the condition of "induced stress plus exercise" revealed no statistical significant differences.

EMG

The mean (±SE) pre-test and "stress period" measures of muscle tension, measured through electromyography (EMG) and recorded in microvolts (uV), for each experimental condition ("exercise," "induced stress," and "exercise plus induced stress"), are presented in Table 2. The pre-test values of the EMG were 8.0 uV prior to the "exercise" condition, 2 uV before the "induced stress" condition, and 4.0 uV prior to the "exercise plus induced stress" condition. The stress period value of the "exercise condition was 22 uV. This increase of 14 uV from the pre-test mean value was not statistically significant. The stress period value of the "induced stress" condition was 209 uV, an increase of 207 uV above the pre-test level. This increase was statistically significant ($p < 0.05$). During the condition of "exercise plus induced stress," the mean stress period measure was 274 uV. This increase of 270 uV above the pre-test level was statistically significant ($p < 0.05$).

Comparison of the post-test EMG values between the "induced stress" condition and the "induced stress plus exercise" condition revealed no statistical significant differences.

DISCUSSION

The Condition of Induced Stress

There are several modalities by which psychological stress may be acutely induced in individuals (23,24,25). The modality chosen to experimentally induce stress in this study was delayed auditory feedback (DAF). DAF was chosen because it is easily administered, easily reproduced, and there is a large body of literature which substantiates the effectiveness

of DAF as a stressor (10,23,26,27). The significant changes in the physiological indices of stress with DAF (Table 2) indicate that the DAF was effective in acutely inducing stress. A significant (p<0.05) increase in HR of 3.3 bpm above the pre-test level was observed during the DAF (Table 2). This increase supports the findings of Doehring and Harbold (26) who reported a 4.2 bpm increase with thirty seconds of DAF using a 0.15 second speech delay. Aierstock (10) and Badian et al. (23) reported significant increases of HR, which were of greater magnitude than the responses measured in the present study, with five minutes of DAF and a 0.17 second speech delay. The significant increases in SBP of 7.2 to 7.6 mmHg recorded in this study (Table 2) are consistent in direction and magnitude to teh SBP changes reported by Aierstock (10) and Badian et al. (23). These investigators reported SBP changes from 3 to 6.6 mmHg under similar conditions.

Another physiological manifestation that was indicative of the stress response was an increased level of neuromuscular activity, which was monitored by use of EMG. In the present study the increase of 207 uV (p<0.05), above the pre-test level measured during the five minutes of DAF (Table 2) supports the work of Doehring and Harbold (26). Doehring and Harbold reported a similar rise in the EMG activity of the wrist and finger flexors in response to thirty seconds of DAF.

Although the physiological changes with the DAF give an indication of a period of induced stress, the changes in the psychological measures of stress were not as strong indicators of stress. Slight, but insignificant increases in state anxiety, depression, and hostility following the DAF session, were noted in this study (Table 1). These findings are consistent with those of Rankin and Balfrey (29) who reported no measurable change in anxiety, measured with the IPAT 8-Parallel-Form Anxiety Battery (PFAB), following nine minutes of DAF using a 0.27 second speech delay. Despite the lack of measurable changes in anxiety, they were hesitant to infer that DAF did not induce stress. Based on the subjects' reports of anxiousness and disturbance, as well as the established physiological responses to DAF, they felt the lack of measurable change was due to the insensitivity of the PFAB (29).

The MAACL, which was used in the present study, has been shown to be a sensitive and reliable measure of state anxiety, depression, and hostility (19,20). With a proven psychological assessment tool and the significant physiological changes reported with DAF, it was expected that changes in the psychological parameters would be observed. This apparent discrepancy in the psychological response may be due to the nature of the assessment of the psychological variables. The administration of DAF prohibits psychological assessment of stress while the subject is receiving the DAF. To receive the DAF, the subject must read out loud, which precludes his completion of a written psychological assessment during the stress period. The-efore, the subject is not being stressed by the DAF while he is compl cing the MAACL. This is supported by the observation that there is little carry over effect following the cessation of the DAF (27).

The Condition of Exercise Plus Induced Stress

It was hypothesized that the psychological and physiological changes found in the experimental condition of "exercise and induced stress" would

be significantly lower than the combined changes of the "exercise" and "induced stress" conditions. However, the data in Tables 1 and 2 do not support this hypothesis.

During the "exercise and induced stress" condition, all the psychological and physiological parameters increased over the pre-test levels. These increases, with the exception of the change in the level of depression, were statistically significant at the 0.05 level.

Comparison of post-test values between the "induced stress" condition and "exercise plus induced stress" condition for both the psychological and physiological indices revealed no significant differences (Table 1 and Table 2).

Due to differences in design and the approach taken to clarify the relationship of exercise and stress, it is difficult to accurately compare the results recorded in this study to the available literature. However, the results of the present study will be discussed in light of the relevant literature.

The findings reported in this study do not support the results presented by deVries (22,32), Morgan (13,14) and Wood (18). However, there is a basic difference between these studies and the present study. In none of the mentioned studies was a psychic stressor used to induce stress following the exercise. These studies measured psychological and physiological parameters after exercise as the subject rested (12,13,14,18,30). In the present study, a psychic stressor (DAF), was administered following the exercise period. The physiological indices of stress were measured immediately following the cessation of induced stress. This difference in experimental design may account for the marked differences in results.

BIBLIOGRAPHY

1. Selye H: Forty Years of Stress Research: The principle remaining problems and misconceptions. Can Med Assoc J. 1976; 53:115-120

2. Selye H: The stress of life. New York, McGraw-Hill, 1976

3. Vigas M: Contributions to the understanding of the stress concept. In Usdin E, Kvetnansky R, Kopin IJ (eds): Catecholamines and Stress: Recent Advances. New York, Eisevier North Holland, 1980

4. Jenkins C: Recent evidence supporting psychologic and social risk factors for coronary heart disease. N Eng J Med 1976; 294:987-1087

5. Buell JC, Eliot RS: The role of emotional stress in the development of heart disease. JAMA 1979; 242:365-368

6. Glass DC, Krakoff LR, Contrada R, et al.: Effect of harassment and competition upon cardiovascular and plasma catecholamine responses in Type A and Type B individuals. Psychophys 1980; 17:453-463

7. Blumenthal J, Sanders W, Williams R, and Wallace A: Effects of exercise on the Type A (Coronary Prone) Behavior Pattern. Psychosom Med 1980; 42:289-296

8. Francis KT, Carter R: Psychological characteristics of joggers. J Sports Med, 1982; 22:386-391

9. Heinzelmann F, Bagley RW: Response to physical activity programs and their effects on health behavior. Pub Hlth Reports 1970; 85:905-911

10. Aierstock BA: Effects of exercise upon selected physiological responses to a psychic stressor in college women. Dissertation. Philadelphia, Temple University, 1972

11. Bahrke MS, Morgan WP: Anxiety reduction following exercise and meditation. Cogn Ther Res 1978; 2:323-333

12. deVries HA: Tranquilizer effect of exercise: A critical review. Phys Sports Med 1981; 9:47-55

13. Morgan WP: Exercise as a relaxation technique. Prim Cardiol 1980; 6(8):48-57

14. Morgan WP, Horstman DH: Anxiety reduction following acute physical activity. Med Sci Sports 1976; 8:62

15. Morgan WP: Influence of acute physical activity on state anxiety. Proceedings of the National College of Physical Education Association for Men, January, 1973

16. Morgan WP, Roberts JA, Feinerman AD: Psychologic effects of acute exercise. Arch Phys Med Rehab 1971; 52:422-425

17. Wilson V, Berger B, and Bird E: Effects of Running and Exercise Class on anxiety. Percept Motor Skills 1981; 53:472-474

18. Wood DT: The relationship between state anxiety and acute physical activity. Amer Corr Ther J 1977; 31:67-69

19. Zuckerman M, Lubin B: Manual for the multiple affect adjective check list. San Diego, Educational and Industrial Testing Service, 1965

20. Zuckerman, M: The development of an affect adjective check list for the measurement of anxiety. J Cogn Psych 1960; 24:457-462

21. Hull CH, Nie NH: Manova Program: Statistical package for the social sciences (SPSS update 7-9)

22. Winer JB: Statistical principles in experimental design (2nd ed). New York, McGraw-Hill Book Company, 1971

23. Badian M, Appel E, Palm D, et al: Standardized mental stress in healthy volunteers induced by delayed auditory feedback (DAF). Eur J Clin Pharmacol 1979; 16:171-176

24. Obrist PA, Gaebelein CJ, Teller ES, et al.: The relationship among HR, carotid dP/dt, and BP in humans as a function of the type of stress. Psychophys 1978; 15:102-115

25. Sleight P, Fox P, Lopez R, et al.: The effect of mental arithmetic on blood pressure variability and baroreflex sensitivity in man. Clin Sci Mol Med 1978; 55:(suppl 4) 381s-382s

26. Doehring DG, Harbold GJ: the relationship between speech disturbance and psycho-physiological changes resulting from delayed speech feedback. USN School of Aviation Medical Research Report (Project number NM 13 01 99, No. 5), 1957

27. Yates AJ: Delayed auditory feedback. Psych Bull 1963; 60:213-232

28. Atkinson CJ: Adaptation to delayed side-tone. J Speech Hear Dis 1953; 18:386-391

29. Rankin RJ, Balfrey WR: Impact of delayed auditory feedback on the IPAT 8-Parallel-Form Anxiety Scales. Psych Reports 1966; 18:583-586

30. deVries HA: Immediate and long term effects of exercise upon resting muscle action potential. J Sports Med 1968; 8:1-11

BENEFACTORS OF THE
JOURNAL OF THE
ALABAMA ACADEMY OF SCIENCE

The following have provided financial suppport
to partially defray publication costs of the Journal.

AUBURN UNIVERSITY
BIRMINGHAM - SOUTHERN COLLEGE
UNIVERSITY OF MONTEVALLO
AUBURN UNIVERSITY AT MONTGOMERY

CONTENTS

ABSTRACTS

Papers presented at the 61st Annual Meeting
University of South Alabama
Mobile, Alabama
March 15-17, 1984

BIOLOGICAL SCIENCES

Partial Characterization of Chicken Genomic Clones Containing
Myosin Heavy Chain Coding Sequences. Debra M. Moriarity, Kevin J.
Barringer, Jerry B. Dodgson and Ronald B. Young, Dept. of Biological
Sciences, Univ. of Alabama in Huntsville, Huntsville, AL 35899 and
Dept. of Microbiology, Michigan State Univ., East Lansing, MI 48824.

A recombinant library of chicken genomic sequences in the Charon
4A lambda phage strain was screened using a 370 base pair fragment
of the cC128 recombinant plasmid containing the coding sequence of
the 3' end of quail myosin heavy chain (MHC) (Proc. Natl. Acad. Sci.
(1982) 79, 3683). Seventeen clones which hybridized to this probe
were used for further study of the MHC multigene family. Partial
restriction mapping was done for each of the clones. Fragments con-
taining the 3' end of the MHC gene were obtained from several clones,
subcloned into a plasmid vector and amplified in E. coli. One of
these fragments was subjected to further restriction mapping and
sequence analysis. cDNA templated by RNA from various chicken
tissues was hybridized with DNA from each of the clones. The results
indicated that both fast and slow skeletal muscle, embryonic and
possibly cardiac muscle MHC isoforms are represented by these
clones, making them a useful tool for further characterization
of the multigene family coding for this 200,000 dalton contractile
protein, MHC.

MOTIVATIONAL STATE AND CIRCANNUAL CYCLE OF THE EASTERN GRAY SQUIRREL.
William Chitwood, William Vinson, and Robert S. Lishak, Dept. of
Zoology-Entomology, Auburn University, AL 36849

Predator models fashioned to resemble the domestic cat (Felis
catus) were constructed from polyurethane foam and attached to a
monofilament line system for presentation to populations of eastern
gray squirrels (Sciurus carolinensis). Seasonal responses
(vocalizations) and response rates were not consistant but showed
fluctuations which appear to be not related to local weather
conditions.

MORTALITY OF NESTLING AND FLEDGLING MOURNING DOVES IN EAST-CENTRAL ALABAMA. J. Barry Grand, Ronald R. Hitchcock, and Ralph E. Mirarchi. Dept. of Zoology-Entomology, Agri. Exp. Sta., Auburn University, AL 36849.

Mortality rates were calculated from data collected on 74 radio-marked, 48 wing-tagged, 16 banded, and 29 unmarked nestling and fledgling mourning doves (Zenaida macroura) in Lee County, Alabama from 1980 through 1983. Nestlings/fledglings were separated into five categories based on behavioral development: (1) 0-8 days posthatching (PH) (n=90), (2) 9-14 days PH (n=122), (3) 15-19 days PH (n=95), (4) 20-21 days PH (n=51), and (5) 22-30 days PH (n=22). Two-way analysis of variance showed differences among years (P=.03) and age classes (P=.02). Mean mortality rates were lower (P<.10) in age class 2 (15%) than in age class 1 (29%), probably due to the increased ability of nestlings to leave the nest and avoid predation. Mean mortality rates decreased (P<.10) between age class 2 (15%) and age classes 3 (4%), 4 (2%), and 5 (0%). This probably reflected the development of homeo-thermy and flight capability by fledglings. There were no differences (P=.10) in mean mortality rates among age classes 3, 4, and 5. Weather related mortality was relatively constant for age classes 1 (10%) and 2 (7%) and absent from subsequent age classes. Avian predation was relatively constant for age classes 1 through 4 (4%, 2%, 1%, 2% respectively) and absent from age class 5. Reptilian predation was constant for age classes 2 and 3 (2%), but absent from age classes 1, 4, and 5. Mammalian predation was observed only in age class 2 (2%). Five sources of mortality were evident when all age classes were combined (n=51): weather related (33%), avian (18%), reptilian (8%), and mammalian (4%) predation, abandonment (2%), and uncertain (35%).

NOTES ON AREA AFFINITY IN WHITE-TAILED DEER AS DETERMINED BY RADIO-TELEMETRY. Tim L. Ivey, South Carolina Wildlife and Marine Res. Dept. Union, SC 29379. M. Keith Causey, Dept. of Zoology-Entomology, and Agric. Exper. Station, Auburn University, AL 36849.

During an intensive study to determine the movement, activity, and behavior of unhunted white-tailed deer during rut, telemetry data was obtained that supports the concept that the home range of deer may be learned. The home ranges of 2 radio-tagged does were very similar in shape and size. The areas occupied were for the most part spatially concurrent yet the 2 does were known to associate or move together only during 2.5 weeks of the 6 month study period. The data suggests the possibility that the similarity in ranges was a result of prior utilization of the same area as members of the same social unit. The significance of area affinity in relation to social organ-ization is discussed.

Abstracts

FISHES FROM THE UPPER TALLAPOOSA RIVER AND THREE OF ITS MAJOR
TRIBUTARIES IN ALABAMA. J. Malcolm Pierson, R. Stephen Krotzer and
Edmond J. Tyberghein, Dept. of Environmental Affairs, Alabama Power
Company, G.S.C. #8, Varnons, AL 35040

    Fishes were collected quarterly at three sample stations on the
upper Tallapoosa River and one station from the lower reaches of each
of three of its major tributaries from October 1981 to December 1983.
Additional collections were made in the recently impounded Harris
Reservoir and the tailrace downstream of Harris Dam. Collections made
by seining and electrofishing yielded a total of 16,487 specimens
representing 11 families and 55 species. A list of fishes collected is
presented with numbers of each species collected, percentage relative
abundance and percentage of occurrence of each species. Catch per unit
effort for all species combined was greater at the three tributary
stations when compared with the river stations. Species diversity was
greatest in Emuckfaw Creek and least in Cornhouse Creek. A total of 49
and 44 species of fishes was collected from all river and tributary
stations respectively. The most abundant fishes collected from the
Tallapoosa River included the Alabama shiner (Notropis callistius),
blacktail shiner (Notropis venustus) and bronze darter (Percina
palmaris). Dominant fishes collected from the tributaries included the
Tallapoosa shiner (Notropis gibbsi), blacktail shiner and Alabama
shiner. Six species were collected in the river but not collected in
the tributaries or reservoir, while four species were collected in the
tributaries only. Three species were collected in the reservoir but
not collected in the river or tributaries. An annotated list of all
species collected is presented with notes on abundance, habitat
preferences and distribution within the study area.

PHOSPHORYLATION OF THE VITELLOGENINS OF ACHETA DOMESTICUS. MICHAEL E.
COX, James T. Bradley, Dept. of Zoology-Entomology, Auburn University,
Auburn University, AL 36849.

    Acheta domesticus vitellogenins (VG) and vitellins (VN) have been
shown to exist as two distinct proteins, each of which consists of
unique heavy and light chain polypeptides. Cricket VG and VN were
radioactively labelled in vivo by injection of [^{32}P] phosphate into
the haemocoel, indicating that cricket VG and VN are phosphoproteins.
Phosphate labelling was restricted to the two heavy VG and VN
polypeptides. Incorporation of [^{32}P] phosphate into haemolymph VG and
egg VN correlated directly with [^{35}S] methionine incorporation, but no
detectable [^{32}P] phosphate was incorporated into VG precursor proteins
in the fat body. These results suggest that phosphorylation of VG is
a post-translational modification which may accompany VG secretion
into the haemolymph.

132

SAMPLE PREPARATION AND ATOM1C ABSORPTION ANALYSIS OF OYSTER TISSUE.
Lisa A. Moore, Marine Environmental Science Consortium, Dauphin
1sland, Alabama 36528.

The oyster is included in the diet of the majority of people who
enjoy seafood. These filter-feeders and other aquatic organisms can
be a significant source of toxic metals, potentially causing disease.
An improved method for estimating the concentration of Cd, Pb, Ni, V,
Cu, and Zn is the subject of this report. Oyster tissue containing
known amounts of the metals was obtained from the National Bureau of
Standards. The tissue was solubilized with a mixture of HNO3, H2SO4,
and HCLO4 in a Kjeldahl flask. Matrix interference and sample size
was reduced by chelating and extracting the digested tissues with
ammonium pyrrolidinecarbodithioate (APCD) and methyl isobutyl ketone
(M1BK). The complete extraction of metals from the aqueous phase was
dependent on the pH and the presence of perchlorate ions, high ph in-
creases the solubility of MIBK in the aqueous phase and decreases the
binding of the chelating agent to the metal. The stability of the
complex was also enhanced by filtration of the organic phase through
sodium sulfate to remove water dispersed in the M1BK. The signal/
ratio was significantly increased by this step due to the elimination
of water in the M1BK. The solutions were found to be stable at -120 c
and could be stored until analysis with no loss or change in metal
composition. Optimal instrument conditions for a Perkin-Elmer 503 AAS
were determined to be as follows: burner height 3.3 mm, oxidant flow
rate 56 1/min., fuel flow rate 23 1/min., and nebulization rate 4.3
ml/min. To maintain a proper signal/noise ratio, and prevent nebuliz-
er and burner slot clogging, acetone was aspirated every five to eight
samples. 1mprovement in efficiency and precision was obtained using
this method.

GRAY SQUIRREL ALARM CALLS PRODUCED IN RESPONSE TO A PREDATOR MODEL.
William Vinson and Robert S. Lishak, Dept. of Zoology-Entomology,
Auburn University, AL 36849.

Alarm calls produced by gray squirrels (Sciurus carolinensis) in
response to a model cat were recorded on the Auburn University campus
and a representative sample of call sequences was spectrographically
analyzed. Four note types were identified (kuk, quaa, modulated quaa,
and modulated quaa-moan) and means for note duration and internote
interval for each note type were determined. The mean values were
compared (Duncan's Multiple Range Test) to those determined for pre-
viously recorded alarm calls from unprovoked and invisible predator
provoked squirrels. Only the mean internote intervals among cat pro-
voked modulated quaas proved significantly different from those of the
other two groups. On this basis predator specific alarm calls by gray
squirrels can not be substantiated.

Abstracts

EFFECTS OF NEUTRALIZATION AND SULFITE TREATMENT ON THE INORGANIC ION COMPOSITION AND BIOCONVERSION OF HEMICELLULOSIC HARDWOOD HYDROLYZATES TO ETHANOL. R. C. Strickland and M. J. Beck, Tennessee Valley Authority, Division of Chemical Development, Muscle Shoals, AL 35660.

As part of a program to develop efficient, cost-effective methods for production of ethanol from hardwood, the relationship between bioconversion and the inorganic elements in oak hemicellulosic hydrolyzate was evaluated. Hydrolyzates were prepared in two stages using steam and dilute sulfuric acid to sequentially hydrolyze hemicellulose (first stage) and cellulose (second stage). The first-stage hydrolyzate contains most of the xylose from the wood; the second-stage hydrolyzate contains high levels of glucose. Pachysolen tannophilus was used to convert first-stage hydrolyzates, which had been neutralized using different bases, both with and without sulfite treatment. Ethanol production was improved by overliming with $Ca(OH)_2$ and the addition of $NaSO_3$. Overliming, with or without sulfite treatment, had little effect on removal of heavy metals, but the concentration of furfural, an organic inhibitor of fermentation, was decreased. High concentrations of sulfate remained after overneutralization with $Ca(OH)_2$ or $CaCO_3$, but $Ba(OH)_2$ effectively reduced sulfate levels. With sulfite treatment, KOH was the superior base for overneutralization. Ethanol also was produced after overneutralization with NaOH or NH_4OH. Sulfite treatment generally improved conversion; however, no ethanol was produced from hydrolyzates neutralized with $Ba(OH)_2$ or $CaCO_3$. Improved fermentation after overneutralization and sulfite treatment was not clearly associated with changes in inorganic element composition of hydrolyzates, and was probably more related to the detoxification of organic inhibitors.

MORPHOLOGICAL CHANGES IN THE DEVELOPING FOLLICLE OF THE HOUSE CRICKET ACHETA DOMESTICUS. John C. Dennis and James T. Bradley. Dept. of Zoology-Entomology, Auburn University, AL 36830.

Follicles of the House Cricket Acheta domesticus in several stages of development were surveyed by light microscopy. Follicles were staged into size classes ranging from 0.75 mm (Stage I) to ≥ 2.0 mm (Stage IV). Accumulation of yolk protein is presumably by endocytosis via the coated pit pathway. Yolk protein deposition begins prior to Stage I and continues at least into Stage II (1.15 to 1.35 mm). Follicle cells in the early stages are columnar to cuboidal. The nuclei are deeply furrowed and their long axes are perpendicular to the oocyte surface. Follicles in Stages III (1.5 to 1.75 mm) and IV are squamous. Nuclei of these cells appear lobular with the long axis approximately parallel to the oocyte surface. Follicle cells in these stages appear to contain more lipid than epithelium cells of the earlier stages.

THE EFFECT OF PHYSICAL POSITIONING ON MEASUREMENT OF WHOLE-BODY ^{65}ZN BURDEN IN POPILIUS DISJUNCTUS. Lawrence C. Wit and William H. Mason, Department of Zoology-Entomology, Auburn University, AL 36849

This study was undertaken to ascertain if the physical positioning of Popilius disjunctus (Illiger) in the detector well would affect determinations of whole-body ^{65}Zn depletion. Measurements of whole-body ^{65}Zn were made on days 0, 1, 2, 3, 5, 7, 9, 12, 15, 18, and 25 post labeling with the beetles in both a head-down and tail-down position within the detector well. Data recorded from beetles in the tail-down position gave the appearance that the ^{65}Zn was eliminated more rapidly than when data were recorded from the same beetles in the head-down position. Unequal distribution of the nuclide within the animals, and the role of the distal ilium in absorption and storage of zinc, are discussed as possible explanations for these results.

EFFECT OF LEAD SHOT INGESTION ON MOURNING DOVE REPRODUCTIVE SUCCESS. Theodore T. Buerger, Ralph E. Mirarchi, Michael E. Lisano, Dept. of Zoology-Entomology, Agri. Exp. Sta., Auburn Univ., AL 36849.

The effect of lead shot ingestion on the reproductive success of female mourning doves (Zenaida macroura) was investigated during the 1982 breeding season. Captive doves were randomly paired and assigned to individual breeding cages (49cm x 33cm x 23cm) 2 weeks prior to the start of the experiment. An artificial lighting regime that simulated the natural photoperiod was provided together with an ad libitum supply of food (Purina Pigeon Chow Checkers, corn, millet, oyster shell grit) and distilled water. On 31 January treatment females (n=25) were force-fed 1 #8 commercial lead shot ($\bar{X}$=0.072g) while control females (n=25) were fed a placebo. Paired doves then were allowed to conduct normal reproductive activities until the experiment was terminated on 26 September. All eggs laid during the experiment were measured, weighed, and artificially incubated. Any squabs that hatched were sacrificed and weighed. Comparisons between treatments were made for egg measurements (length, width, weight), productivity, fertility, hatchability, and squab weight. No differences (P>0.05) in egg measurements, productivity, fertility, or squab weight occurred between treatments. A difference (P<0.05) in hatchability did occur between treatments because of a higher incidence of early embryonic mortality (0 to 9 days of age) among embryos from treated doves. These data indicate that lead ingested accidently by mourning doves prior to, or during, the breeding season may significantly decrease their reproductive success. (Supported by an Alabama Academy of Science Student Research Grant and AAES Project No. 13-0048).

RITUALIZATION IN THE EVOLUTION OF VERTEBRATE CHEMICAL COMMUNICATION.
William R. Garstka, Department of Biological Sciences, Univ. of
Alabama in Huntsville, Huntsville, AL 35899.

Ritualization is an evolutionary process that involves the
co-opting of some pre-existing condition into the communication
repertoire of a species; that is, some trait that is functional in
another context acquires signal value. Two vertebrate sexual pheromone
systems fit a ritualization hypothesis well. Snakes sequester
lipoproteins in the skin; these lipoproteins are necessary for skin
proliferation and shedding and may also function as a part of the
skin barrier to water loss. The major lipoprotein synthesized by
female garter snakes is vitellogenin, the circulating precursor of
yolk, and immunoreactive vitellogenin is present in their skin. Male
garter snakes have taken advantage of the presence of this material,
or some derivative of it, in the skin to identify females. Further,
species distinctions and fecundity distinctions may be based on this
pheromone. There is some indication as well that females may release
skin secretions, and therefore pheromone while being courted. Major
Histocompatibility Antigens (H2 in mice) function in cellular
immunorecognition. They also affect the biosynthetic pathways of
steroid hormones and placentation. Thomas' group reports that male
mice are capable of olfactory discrimination by MHC type, and further,
that male mice choose to outcross by MHC type in mate choice trials.
Billington has reported that outcross by MHC type in mice results in
larger placentae and larger litters. In each cited case the selective
value accruing to males by capitalizing on the pre-existing female
chemical signals may be enormous. I suggest that these are not
isolated examples, but rather are indicative of a general trend.

RELATION OF PLANTING DATE OF TURNIPS TO LOSSES FROM A MOSAIC DISEASE

Mack A. Wilson and Clauzell Stevens. Department of Agricultural
Sciences, Tuskegee Institute, Tuskegee Institute, AL 36088. R. T.
Gudauskas. Dept. of Botany, Plant Pathology and Microbiology,
Auburn University, Auburn, AL 36849.

During the spring of 1983, a severe virus-like disease occurred
in turnips in experimental plots at Tuskegee Institute. Long,
flexous rod-shaped particles were observed by electron microscopy of
sap from naturally-infected turnip leaves. Turnips were planted on
April 25, May 2, May 9, September 15, September 22, and September 29.
Incidence of the disease by planting date, was May 2 -5%, May 9 -10%,
and April 25 -60%; no disease developed in the fall plantings.
Highest disease ratings and greatest yield losses occurred in the
April 25 planting. Altering the date of planting may have avoided
peak vector population or increased plant resistance to infection.

Abstracts

INFLUENCE OF VARIOUS STORAGE CONDITIONS ON THE BACTERIOLOGICAL QUALITY OF OYSTER SHELLSTOCK. L. H. Hopkins and R. F. Modlin, University of Alabama, Huntsville, Dept. of Biological Sciences, Huntsville, AL 35899. A. DePaola, Fishery Research Branch, Food and Drug Administration, Dauphin Island, AL 36528.

The effects of various storage conditions on the bacteriological quality of oyster shellstock were examined. The oysters, Crassostrea virginica, were acclimated to estuarine conditions in a flow-through system and then dosed in recirculating estuarine water overnight with cultures of Vibrio cholerae and Vibrio vulnificus. The oysters were removed from the water and stored at ambient temperatures up to 48 hours and at 3 C for up to 15 days. Experiments were conducted in September and November 1983 and January 1984. Official bacteriological procedures were compared to other methods for the enumeration of total aerobic microflora, fecal coliforms and V. cholerae. In general, bacterial counts did not change when oysters were stored at ambient temperatures for 48 hours. When oysters were stored at 3 C, total aerobic counts increased 2 to 3 logs at 10 days, V. cholerae numbers were unchanged and V. vulnificus recovery decreased. In the 1st two experiments fecal coliforms were not detected, so oysters were dosed with agar-grown Escherichia coli strains in the January study. E. coli numbers in the stored oysters remained fairly constant with either refrigerated or ambient storage in this experiment. In general, the official procedures were equivalent or superior to other methods except with aerobic plate counts. Counts from marine agar and plate count agar supplemented with 1% NaCl were one to two logs higher than with standard plate count agar without added NaCl.

DAILY ACTIVITY OF BLARINA BREVICAUDA IN CAPTIVITY. Larry L. Crowell, Dept. of Zoology-Entomology, Auburn University, AL 36849.

Observations were taken on a single male shrew for a period of 27 days. Five activities were recorded: 1) tunneling/reconstruction, 2) capture of prey, 3) storage of prey, 4) feeding, and 5) sleeping/ resting. The duration of each activity and the sequence of occurrence were recorded. Domestic mice, house crickets, and earthworms constituted the majority of the food items given. Each food item was weighed and provided alive. Results indicate that the captive consumed approximately 1-1.5 times its body weight each day. Activities with respect to duration can be arranged as 1, 5, 2, 4, and 3 where activity 1, tunneling/reconstruction, represents the longest in duration. Activity 2 was dependent on the availability of food items. The storage of prey was subsequent to activity 2. Feeding was recorded as subsequent to activities 1, 2, 3, or 5. Activity 5 was commonly recorded to occur between activities 1, 3, 4, and 5. Additional observations concerning habits and behavior are described.

EFFECTS OF FURFURAL ON BIOCONVERSION OF XYLOSE TO ETHANOL BY PACHYSOLEN TANNOPHILUS. Mary J. Beck and John E. Jordan, Tennessee Valley Authority, Division of Chemical Development, Muscle Shoals, Alabama 35660, and T. A. McCaskey, Auburn University, Auburn, Alabama 36849.

Furfural is a product of the degradation of pentose by hot acid. It is formed as an undesirable by-product of the dilute acid hydrolysis of hemicellulose. The conditions which favor the release of pentoses also contribute to the formation of furfural. Furfural has been demonstrated to be toxic to such yeasts as Saccharomyces cerevisiae which convert hexoses to ethanol. Biomass resources, such as hardwood, are potential sources of sugars to produce ethanol through bioconversion. One quarter of the dry weight of hardwood is hemicellulose. Pentoses, mainly xylose, which comprise most of the hemicellulose fraction could add to the yield of ethanol from hardwood. Recently a yeast, Pachysolen tannophilus, has been found which has the ability to convert xylose to ethanol. This study shows the effects of furfural on growth, xylose consumption, and ethanol production by P. tannophilus. At levels of 0.05% furfural or greater, inhibition is evident. At 0.15%, inhibition is complete. Repeated exposure of P. tannophilus to 0.1% furfural does not result in acclimatization of the yeast to furfural. Prolonged exposure results in an increased lag in the onset of growth, xylose consumption, and ethanol production. Furfural is metabolized by P. tannophilus. As levels are decreased to 0.05% or less by the yeast, xylose assimilation resumes. Furfural levels in hydrolyzates of hardwood reflect the conditions of temperature, acid concentration, and duration applied in their production. Furfural can be diminished through certain treatments of the hydrolyzates allowing better yields of ethanol by P. tannophilus.

SOYBEAN VARIETAL EFFECTS ON THE SEASONAL ABUNDANCE OF THREECORNERED ALFALFA HOPPERS. Carole B. Backman and T. P. Mack, Dept. of Zoology - Entomology, Auburn, AL 36849

Seven soybean varieties (Davis, GA Soy 17, Coker 237, Tracey M, Wright, Braxton, and Bragg) were planted at the Blackbelt Substation of Auburn University at Marion Jct., AL. Davis and Tracey M are Group 6 varieties (early maturing) and the others are Group 7 varieties suited for growing in Central Alabama. A randomized complete block design with four replications was employed with each plot being 12 rows by 50 feet. Bacillus thuringiensis (2 lb ai/acre) was applied at ca. 10 day intervals to reduce foliar feeding insect populations. The field was monitored weekly for threecornered alfalfa hopper populations by randomly sampling three, 6-feet sections using the shake cloth method in each plot. Data was analysed by analysis of variance and Duncan's multiple range test. There were some significant differences between varieties on several of the sampling dates and the two Group 6 varieties had lower total mean populations of three-cornered alfalfa hoppers over the entire growing season.

γ-CARBOXYGLUTAMATE-CONTAINING PROTEINS SYNTHESIZED BY RAT MOLAR TOOTH GERMS IN VITRO.   Richard D. Finkelman, Michael T. DiMuzio and William T. Butler, Institute of Dental Research, Univ. of Alabama in Birmingham, Birmingham, Alabama 35294

Previous investigations have identified γ-carboxyglutamate(Gla)-containing proteins in adult rat incisor dentin.   The purpose of this study was to identify dentin Gla-containing proteins in the developing rat molar.

We have utilized an in vitro model to follow the biosynthesis of the dentin Gla-containing proteins.   Maxillary third molar germs were dissected from twelve-day Sprague-Dawley derived rat pups and cultured according to the methods of Navia et al. (manuscript submitted) with slight modifications.   On day seven of culture, tooth germs were incubated with [^{3}H]-leucine (10 μCi/ml) for 24 hrs.   Radioactivity was chased for 1 hour with fresh, unlabeled media.   Tooth germs were harvested, pooled and immediately placed in a solution of 4 M guanidine chloride, 0.2 M EDTA and protease inhibitors.   This solution was sonicated and centrifuged to remove remaining cellular debris.   Unincorporated counts were removed by PD-10 chromatography. The total sonicate was analyzed for Gla-containing proteins by molecular sieve and reversed phase HPLC.   In addition, the total sonicate was separated by SDS-PAGE. A minor peak was seen to coelute with [^{125}I]-labeled, adult rat dentin Gla-containing proteins on both molecular sieve and reversed phase HPLC. A minor band comigrated with [^{125}I]-labeled adult rat dentin Gla-containing proteins on SDS-PAGE. We conclude that dentin Gla-containing proteins are synthesized by rat third molar tooth germs in vitro.

DEVELOPMENT OF EIMERIA TUSKEGEENSIS (PROTOZOA: EIMERIIDAE) FROM THE COTTON RAT, SIGMODON HISPIDUS, IN CELL CULTURES. David S. Lindsay and William L. Current, Dept. of Zoology-Entomology, Auburn University, AL 36849.

The in vitro development of Eimeria tuskegeensis was examined after inoculation of sporozoites into monolayers of established cell lines of human embryonic lung cells and rabbit kidney cells.   Sporozoites developed into immature second-generation meronts in human embryonic lung cells but did not develop beyond intracellular sporozoites in rabbit kidney cells.   Nuclear division occurred in sporozoites forming sporozoite-shaped meronts.   Sporozoite shaped meronts developed to first-generation meronts which had 7 to 22 nuclei and formed from 8 to 22 first-generation merozoites.   Immature second-generation meronts with 2 to 6 nuclei developed from some first-generation merozoites often within the same host cell.   Refractile bodies were present in all developmental stages observed.   Sporozoites were the only motile stages observed in cell culture.

"Genetic characterization of a population of <u>Scyllarides nodifer</u> using isoelectric focusing (IEF) of some gene products." <u>Charles W. Hardwick</u> and George B. Cline, Dept. of Biology, UAB, Birmingham, AL. 35294.

Electrophoretic patterns of proteins and of isozymes can be used to measure genetic relationships among animals and populations. In this progress report, IEF is used to assess the biochemical characteristics of 15 slipper lobsters from 2 locations 25 miles south of Pensacola, FL. IEF is done in thin-layer agarose gels containing ampholytes, pH range 4-7. The focused gels are assayed for gene products by one of two methods. Single Commassie Blue R-250 protein bands are at pI <u>4.80</u>, <u>4.90</u>, <u>5.50</u>, and <u>6.50</u>, with the 5.50 band showing the greatest intensity range. One (or 2) weakly-staining band(s) is present at <u>4.70</u>, <u>4.75</u>(2), <u>5.60</u>, 5.65, <u>5.80</u>, <u>5.90</u>(2), <u>6.15</u>, <u>6.20</u>, <u>6.25</u>, <u>6.45</u>, 6.55, and 6.60 (underlining indicates presence in all animals). These data suggest that these animals belong to a single population. Genetic loci and allelic variation can be better determined by isozyme analysis. Isozyme visualization is carried out on substrate membranes through coupled reactions with a tetrazolium indicator. Phosphoglucomutase assays show 8 alleles at 5.30, 5.50, <u>5.80</u>, <u>5.90</u>(2), <u>6.10</u>, <u>6.25</u>, 6.30(1, 2), and 6.50(1,2,3) from 4 probable loci. Phosphohexose isomerase assays show 10 alleles at 5.30, 5.40, <u>5.60</u>(1,2), <u>5.85</u>(1,2), 5.95, <u>6.10</u> (2,3), <u>6.20</u>(2), <u>6.35</u>(2), <u>6.50</u>(1,2), and <u>6.60</u>(1,2) from 6 probable loci. The isozyme patterns obtained in agarose are similar to patterns in acrylamide published previously with small differences in pIs (1). The PGM and PHI patterns also indicate these animals share the same gene pool. Preliminary data on mannose phosphate isomerase show a high degree of variability and that MPI is not sex-linked as it is in other lobster species.
(1) Cline,G.B. and Hinton,J. (1983) Isozyme Bulletin, 16 p.78.

THE EFFECT OF CHRONIC COLD-STRESS ON IN VITRO ADRENAL CORTICOSTERONE SECRETION IN THE RAT. <u>B.D. White</u>, J. F. Pritchett, D.N. Marple, C.H. Rahe and J.T. Bradley, Auburn University, Auburn, AL 36849.

In vitro corticosterone secretion of mixes of cortical and medullary tissue derived from both control animals and animals exposed to 5 C for 5 weeks were analyzed to determine the possible involvement of the adrenal medulla on elevated levels of corticosterone during chronic cold-stress. Stressed cortices, in the presence of stressed medullary tissue secreted significantly greater quantities of corticosterone than control cortices in the presence of control medullary tissue. However, corticosterone secretion of stressed cortices, in the presence of control medullary tissue, was not significantly different from that of control cortices in the presence of control medullary tissue. Thus, it appeared that the increased corticosterone secretion in media which contained stressed cortical and stressed medullary tissues was not due to the state of cortex, but rather involved an interaction between the cortex and medulla.

MELANISM AND REPRODUCTION IN THE MALE SLIDER TURTLE, PSEUDEMYS SCRIPTA. Charles W. Terrell and W.R. Garstka, Department of Biological Sciences, Univ. of Alabama in Huntsville, Huntsville, AL 35899.

Males of many species of Pseudemys turtles are known to darken with age. In male P. scripta, this darkening is first manifest in a reorientation of shell black pigment to the scute margins and in a breakdown of body striping patterns. Final darkening of the shell consists of filling in the now pattern-free scutes with black. Sexual maturity, as evidenced by active spermiogenesis on histological examination and by the development of secondary sex characters, occurs in male P. scripta at approximately 100mm plastron length (PL). The smallest males evidencing melanism in our samples were 140-150mm PL, and every male greater than 170mm PL was melanistic. Melanistic males exhibited a suite of growth related characters that are allied with reproduction. Seminiferous tubule diameter was greatest in melanistic males. Relative liver weight was greater in melanistic males. Foreclaw length declined with size and was shortest in melanistic males. However, there were also reproductive differences among male groups that are apparently not directly related to growth. Previous stored sperm disappeared completely from the ductuli deferentia of melanistic males in August before new sperm first appeared in September. Spermiogenesis began 1 month earlier (July) in melanistic males. The ratio of serum cholesterol to total serum lipid during maximal gonadal recrudescence was much reduced in melanistic males. Although we are beginning to understand the mechanism of melanization in male P. scripta, the causative factor(s) and their possible connection with reproductive processes are still not understood.

ORGANIC POLLUTANTS IN OYSTERS (CRASSOSTREA VIRGINICA) OF MOBILE BAY. Ken R. Marion, Biology Department, and Steven A. Barker and Robert L. Settine, UAB GC/MS Center, University of Alabama in Birmingham Birmingham, AL   35294

The results of the first two years of a long-range study of oysters (Crassostrea virginica) in Mobile Bay as biological indicators of organic pollutant pressure on the estuary are presented. Pollutants were identified and quantified by using gel permeation chromatography followed by fused silica capillary GC/MS analysis. The results indicate a wide variety of organic contaminants occur in oysters from Mobile Bay. Aromatic hydrocarbons, aliphatics and chlorinated hydrocarbons are among the chemical groups represented. Individual concentrations of any one contaminant are in the ppb range, and a potential human health hazard or severe toxic organic contamination of oysters is not presently indicated. Inter-site, seasonal and annual variation in types and quantities of organic pollutants has been demonstrated. Such data will be invaluable as an essential environmental baseline for the future evaluation and planning of industrial development in the Bay.

FORAGING BY CALLINECTES SAPIDUS WITHIN SPARTINA MARSHES. Dana
West and Ann H. Williams, Dept. of Zoology-Entomology, Auburn
University, Auburn, AL 36849

This study examined predation by the blue crab, Callinectes
sapidus, within intertidal Spartina alterniflora marshes of Dauphin
Island, Alabama during 1982-83. Species and size preferences
displayed by the predator when foraging within the marsh were
investigated using nektonic, epifaunal, and infaunal prey
populations. Prey species utilized included Fundulus similis,
Littorina irrorata, and Geukensia demissa. Short term field
experiments involving the use of predator inclusion cages in which
the relative abundances of all prey species were manipulated
indicated that mean mortality differed significantly among species.
Mean mortalities as percents (+ SD) for Littorina, Fundulus and
Geukensia, respectively, were 27.4% (13), 14.8% (13), and 2.4% (2.5)
for all twelve hour experiments. Blue crabs exhibited a distinct
species preference for Littorina, and to a lesser extent, for
Fundulus. However, the predator rarely choose infaunal individuals.
Within predator-inclusion cages, size selection among three size
classes of each prey by the crabs were evident for Littorina and
Fundulus but not for Geukensia. Thus, blue crabs tend to select
intermediate sized snails and large fish while not exhibiting a
preference by size for infaunal bivalves. Observational data
collected over four months during the summer of 1983 provide
evidence of size-selection by blue crabs within populations of
Littorina.

SOCIAL ORGANIZATION OF WHITE-TAILED DEER DURING RUT. Tim L. Ivey,
South Carolina Wildlife and Marine Res. Dept., Union, SC 29379.
M. Keith Causey, Dept. of Zoology-Entomology and Agric. Exper.
Station, Auburn University, AL 36849.

Visual observation was used to obtain data on group composition
of white-tailed deer on the Fred T. Stimpson Wildlife Sanctuary in
Clarke County, Alabama from November 1975 through March 1976. Eval-
uation of group composition was divided into 3 periods (pre-rut, 6
Nov - 6 Jan; rut, 7 Jan - 29 Feb; post-rut, March) to determine if
reproductive behavior affected group composition on the sanctuary.
During the study, 937 groups containing 2391 deer were sighted. The
sightings of single males and single females increased during the rut.
Mean group size also decreased during the rut, with 54% of all groups
sighted containing 2 or fewer individuals. The data suggest a tempo-
rary disassociation of adult does from family groups as a result of
reproductive activities. Based on observation of radiotagged does
the disassociation occurs primarily between adult deer or yearlings
and may not affect most fawn-doe associations.

Abstracts

PUBERTY ATTAINMENT OF WILD HATCHING-YEAR MOURNING DOVES IN ALABAMA.

Lisa I. Muller, Ralph E. Mirarchi, and Michael E. Lisano. Dept. of Zoology-Entomology, Agri. Exp. Sta., Auburn University, AL 36849.

Mourning doves (Zenaida macroura) were live-trapped in east-central Alabama during selected portions (7 July - 7 October 1981 and 28 June - 25 September 1982) of the dove breeding season. One hundred seventy hatching-year (HY) birds (79 males, 91 females) with primary feather replacement (PFR) designations 05-10 were sampled. All doves were held in captivity overnight and sacrificed at 1100 hrs the next morning. Carcasses then were examined for reproductive activity and crop gland development. Crop and gonadal characteristics were used to classify doves as either successful nesters (SN), imminent egglayers (IE), potential breeders (PB), marginal breeders (MB) (males), or nonbreeders (NB). HY doves with any evidence of puberty attainment were categorized as being potentially reproductively active (PRA). PRA males included SN, PB, and MB while PRA females included SN, IE, and PB. Significantly (P<0.05) more males (20%) than females (3.5%) were categorized as being PRA. Testes of HY males attained puberal weights (paired weights $\geq$ 150 mg) and had spermatozoa present between 80 and 93 days of age. Females exhibited ovarian development indicative of puberty attainment after 93 days of age. In both males and females, potential for reproduction tended to increase with age provided development occurred during the height of the breeding season. HY birds collected near the end of the season showed little indication of puberty attainment possibly due to the constraints that decreasing photoperiod placed on reproduction (Supported by USFWS Contract No. 14-16-0009-81-003).

ISOLATION OF SPIROPLASMA FLORICOLA FROM FLOWERS IN ALABAMA

Clauzell Stevens, Department of Agricultural Sciences, Tuskegee Institute, Alabama 36088. Reynolds M. Cody and Robert T. Gudauskas, Department of Botany, Plant Pathology and Microbiology, Auburn University, Alabama 34849. Algem Patterson, Department of Agricultural Sciences, Tuskegee Institute, Alabama 36088.

Spiroplasma floricola was isolated from surfaces of flowers collected from Prunus angustifolia (DPRCL3) in Autauga County, and from P. persica (PEA60) and Magnolia solangeana (AUCL3) in Lee County. The isolates metabolized sugars and arginine, did not hydrolize urea, and grew at 20-37°C. The isolates formed satellite colonies on 2% agar medium, but highly diffused colonies on 1% agar. Serological comparisons with other members of the Spiroplasmataceae using the organism deformation test showed the isolates were serologically indistinguishable from S. floricola OBMG strain from Maryland. Triply-cloned isolates were deposited with the American Type Culture Collection (ATCC) as ATCC 35006 (AUCL3), ATCC 35007 (DPRCL3), and ATCC 35008 (PEA60).

SPERM STORAGE AND CAPACITATION IN THE MALE SLIDER TURTLE, PSEUDEMYS SCRIPTA. Markus Gross and W.R. Garstka, Department of Biological Sciences, Univ. of Alabama in Huntsville, Huntsville, AL 35899.

Male P. scripta in our study exhibited annual gonadal recrudescence beginning in July and continuing through October. Breeding seasons in turtles are poorly documented, and in P. scripta breeding may occur in fall, spring, and midsummer. We began our investigation with the hypothesis that if spring breeding were to occur, the males must have some mechanism to maintain sperm viability. Viable sperm were observed in the ductuli deferentia of male P. scripta through July. We have recorded cyclic changes in the epithelial lining of the middle ductus deferens coincident with sperm replacement. Beginning in July there was a proliferation of the lining of the ductuli such that by August or September the lining was two or more cells thick. During October, the inner, older layer of cells sloughed into the lumen. There was a second proliferation in November, but instead of forming two cell layers, a convoluted epithelium was apparent. The lining cells were also hypertrophied at this time, and freshly transformed sperm were present in the ductuli as well. Some of these sperm were seen within the folds of epithelium, but not in any regular array. Although secretions of a modified portion of the nephron are known to have a capacitation effect on the sperm of lizards, no such nephron modification is documented in turtles. However, we have observed apparently secretory cells in the kidney tubules of male P. scripta. This work was supported in part by UAH BYS 8384 P2 to M.G.

EFFECTS OF EXTRACTS OF HUMAN HAIR ON DEER ACTIVITY IN COTTON FIELDS. M. Keith Hudson and M. Keith Causey, Dept. of Zoology-Entomology, Alabama Agricultural Experiment Station, Auburn University, AL 36849. Ken S. Rymal, Dept. of Horticulture, Alabama Agricultural Experiment Station, Auburn University, AL 36849.

White-tailed deer (Odocoileus virginianus) activity levels in selected Alabama cotton fields were measured by daily counts of tracks across tilled transects during July - October 1982. Fields were treated with various applications of extracts made from human hair clippings, human hair, colored political placards, and plain cotton balls. Activity levels were compared before and after selected treatments. Significant changes in activity levels occurred (P.<.05) but could not be attributed to the treatments of human hair extracts. Substances extracted from human hair and/or human hair may have value in repelling deer from certain agricultural crops but many variables not addressed in this study must be considered.

Abstracts

EFFECTS OF TEMPERATURE AND HOST PLANT ON THE MORPHOLOGY OF SCALE
INSECTS (HOMOPTERA:DIASPIDIDAE). <u>Michael L. Williams</u> and B. J. Muse,
Dept. Zoology-Entomology, Auburn University, AL 36849.

Research indicates that environmental factors influence taxonomic
characters of armored scale insects. Field data for <u>Aonidomytilus</u>
<u>ceanothi</u>, <u>A</u>. <u>hyperici</u> and <u>A</u>. <u>crookiae</u> collected on a single host plant
genus — <u>Ceanothus</u> spp., <u>Hypericum</u> spp., and <u>Hypericum</u> spp., respect-
fully — showed that the two index meristic (counting) characters used
in the study, submedian macroducts and perivulvar pores, had higher
numbers for specimens collected from cooler temperature zones. Tem-
perature cabinet experiments showed that <u>A</u>. <u>solidaginus</u> reared from
parent scales collected in the same location had higher numbers of sub-
median macroducts and perivulvar pores when reared at $21.3^{\circ}C$ than when
reared at $30.6^{\circ}C$ (P$<$0.001). Differences were also noted in pygidial
lobe forms and gland spine lengths of 3 species, <u>A</u>. <u>concolor</u>, <u>A</u>. <u>albus</u>,
and <u>A</u>. <u>espinosai</u> inhabiting different moisture regions in arid grass-
land and desert areas. Because many scale insects are sessile and un-
able to migrate (except for a brief period during the first stage) when
conditions become unfavorable, they must be very adaptable to adjust to
the extremes of a rapidly changing terrestrial environment. The alter-
ation of taxonomic characters in response to environmental changes may
simply be a passive reflection of this great adaptability. In some
cases it may have some useful function. Perhaps, for example, the
greater number of submedian ducts in strains adapted to cooler temper-
atures may be useful for secreting thicker scale coverings to protect
against cold.

TAKE-ALL DISEASE FOUND ON WHEAT IN ALABAMA. <u>Robert T. Gudauskas</u>,
Dept. Botany, Plant Path., and Microbiol., Auburn Univ., AL 36849.
Austin K. Hagan, Ala. Coop. Extension Ser., Auburn Univ. Gareth
Morgan-Jones, Dept. Botany, Plant Path., and Microbiol., Auburn Univ.
Darrell Williams, Dept. Agron. and Soils, Auburn Univ.

Take-all disease, caused by the fungus <u>Gaeumannomyces graminis</u>,
was found on wheat in seven counties in northern Alabama during the
spring of 1983. Diseased plants occurred in scattered patches of a
few feet to acres in size, and were stunted and chlorotic, and stems
and heads turned tan-colored to white at grain-filling time in green,
healthy plants. Rotting of roots, crowns, and lower stems, and a
superficial dark-colored mass of fungus mycelium on lower stems beneath
the leaf sheath also were apparent. Characteristic perithecia of the
fungus were found embedded in the lower leaf sheath of diseased plants.
Generally, incidence and severity of take-all were low in most fields
examined in 1983; however, losses to the disease were estimated at 50%
or higher in a few fields. Damage was heaviest in fields that had been
planted to wheat for 5 or 6 successive years.

ELECTROPHORESIS STUDIES WITH SAMPLE CONDUCTIVITY, INSERTION RATES, SEPARATION AND BAND SPREAD. George Williams, Jr., Department of Natural Sciences, Calhoun Community College, Decatur, AL 35602. Robert Snyder and Teresa Y. Miller, NASA, Marshall Space Flight Center, AL 35812.

Tests were made in a continuous flow electrophoresis system using monodisperse polystyrene latex microspheres to determine optimum sample conductivity, insertion rates and optimum electric field applications for future STS flight experiments. The effects of particle interactions on sample resolution and migration using formaldehyde fixed turkey and bovine erythrocytes were also studied. Photographic documentation of particle stream characteristics was also an important phase of the research. Evaluations were made of sample conductivity and buffer conductivity as they affect sample band spread. These samples were prepared from mixtures of five percent and one percent PSL microspheres with diameters of .4, .56 and .7 microns in electrolyte media 1X and 3X the conductivity of the curtain buffer.

Optimum sample flow rates for the selected samples were determined to be approximately 26 µl/min. Experiments with samples in deionized water yielded best results and voltages in the 20 V/cm to 30 V/cm range were optimum. Samples with matched conductivities produced greater resolution and less band spread than those with 3X the conductivity of the curtain buffer.

GROWTH AND BIOCHEMICAL RESPONSES OF Cercospora arachidicola TO PROPICONAZOLE. H. Gary Hancock and John D. Weete, Dept. of Botany, Plant Pathology, and Microbiology, Auburn University, AL 36849

Inhibition of C-14 demethylation in the conversion of lanosterol to desmethyl sterols (e.g. ergosterol) has been demonstrated in several fungi with the experimental agricultural fungicide propiconazole (Tilt 3.6EC). In vitro growth and certain metabolic responses to this inhibitor were determined for Cercospora arachidicola, a foliar pathogen of peanuts. The total lipid (TL) content of mycelium was 10% of the dry weight (DW), most of which consisted of triacylglycerols, whereas phospholipids (PL) accounted for only 0.43% of the DW. Principal fatty acids were oleic, palmitic, and linoleic at 42, 36, and 15% of the total, respectively. Ergosterol was the principal sterol at 47% of the total. CA was considered very sensitive to propiconazole with 50-60% growth reduction at 0.08-0.1 ppm. The TL content was 29% less and the PL content was double that of controls. Treated tissue contained 10% more total sterols than controls with 24-methylene dihydrolanosterol as the major sterol component.

WATER COLUMN STRATIFICATION CHARACTERISTICS OF THE MOBILE BAY ESTUARY.
William W. Schroeder and Thomas S. Hopkins, Mar. Sci. Prog., The
Univ. of Ala., Dauphin Island, AL 36528 and William. J. Wiseman, Jr.,
Coastal Studies Inst., L.S.U., Baton Rouge, LA 70803

Large estuaries of only a few meters in depth are most often
characterized as being vertically well mixed. This is a result of the
feeling that the shallow water columns are easily maintained in a
homogeneous state by moderate to weak winds and tidal currents. Such
has been the general thinking regarding the Mobile Bay estuary which
has an average depth of approximately 3m. Results from the examination
of a number of data sets have revealed that vertical statification
does occur over large portions of the basin. Strong vertical
statification arises principally as a function of salinity gradients,
and is produced in association with periods of both high and low river
discharge. At any given time, the degree of vertical stratification
within the geography of the basin can be highly variable. That is to
say one area may be highly stratified while an adjacent area may
exhibit little or no stratification. The existance of significant and
persistant vertical stratification mandates that careful attention be
paid to the management of this system. For example, since the
traditional approach in modeling circulation has been to assume
vertical homogeneity this knowledge is of particular importance and
needs to be given due consideration.

THE ROLE OF BRANCHIAL CARBONIC ANHYDRASE IN ION REGULATION, ACID-BASE
BALANCE AND CO_3 EXCRETION IN THE EURYHALINE BLUE CRAB, CALLINECTES
SAPIDUS. R.P. Henry, Department of Zoology-Entomology, Auburn Univ.,
AL 36849

A sensitive pH-stat assay was used to study the inter-and
intrabranchial distribution of carbonic anhydrase (CA) in C. sapidus
acclimated to 29 and 8ppt. The enzyme is primarily associated with
the osmoregulatory patches in the lamellae of the posterior gills.
There is both an induction of CA and activation of the enzyme at the
low salinity. In-vivo inhibition of CA by an injection of Diamox in
crabs at 8ppt causes a metabolic alkalosis characterized by elevated
pH and HCO_3 at constant PCO_2. Blood Na and Cl were significantly
lowered, with Cl being lowered proportionally more than Na, thus
altering the strong ion difference (SID). Diamox had no effect on
crabs at 29ppt, and it did not alter O_2 uptake or CO_2 excretion at
either salinity. We conclude that gill CA functions in hydrating CO_2
to HCO_3 and H^+ for counterions in Cl^- and Na uptake in low salinity.
Acid-base balance is a function of the SID and CO_2 excretion is driven
solely by the PCO_2 gradient from blood to water.

FITNESS EFFECTS OF THE LINKED MUTANTS "EBONY" AND "SEPIA" IN DROSOPHILIA MELANOGASTER. J. Gary Yates and Mary U. Ball, Dept. of Zoology-Entomology, Auburn Univ., AL 36849.

A stock of flies homozygous for white (w) sepia (se) and ebony (e) may be crossed with wild type stock to produce an F_2 generation. When performed as a laboratory exercise in our undergraduate genetics course, students routinely obtain fewer than expected of white-eyed, sepia-eyed, or ebony-colored flies. To investigate the factors contributing to these observations, F_2 offspring were raised at each of three constant temperatures ($20^{\circ}C$, $24^{\circ}C$, and $28^{\circ}C$) and in an incubator in which the temperature fluctuated between $17^{\circ}C$ and $25^{\circ}C$. Females developed faster, on average, than did males at all temperatures. On average, red-eyed flies developed more rapidly than did white-eyed flies and sepia-eyed flies developed most slowly. Flies with wild-type body color developed more rapidly, on average, than did ebony-colored flies, at all temperatures. Significantly more females than males were observed at all temperatures. Chi-square tests on daily counts and on cumulative counts indicated that expected Mendelian ratios, if achieved at all, were approached over a period of days, due to the developmental lag of males and of the sepia, white, and ebony phenotypes. In our genetics course additional factors such as misclassification of newly-emerged flies and competition in over-crowded culture bottles may also affect results.

BIOLOGICAL STUDIES ON TRICHOGRAMMA PRETIOSUM, A PARASITOID OF INSECT EGGS. C. A. Kouskolekas and R. J. Jacobs, Dept. of Zoology-Entomology, Auburn Univ., AL 36849.

Eggs of the fruitworm Heliothis zea, the major insect pest of tomato, are frequently attacked by the hymenopterous parasitoid Trichogramma pretiosum. Mass releases of this parasitoid are made in the field as part of programs for integrated management of H. zea. The susceptibility of this biological control agent to insecticides applied on tomato for control of the fruitworm is a key factor in the success of such programs. The sensitivity of T. pretiosum to two commonly used insecticides was tested in the laboratory. Tomato plants were sprayed with permethrin or endosulfan and 1, 3, 7, 14 and 21 days post-spray H. zea eggs were attached to excised leaves, and adult T. pretiosum were exposed to these leaves for 24 hours. Permethrin residues resulted in significantly lower rates of parasitism and significantly higher mortality of T. pretiosum adults than those of the control for 21 days after spray. In contrast, endosulfan residues reduced egg parasitism and increased adult mortality only on day 1 after spray. These data suggest that endosulfan may be compatible, whereas permethrin, because of persistent residues, may adversely impact with T. pretiosum releases.

ESTUARINE TURBIDITY AS A POSITIVE FACTOR IN THE SUCCESS OF THE HYDROLD, BIMERIA TUNICATA.

D. Virginia Nancarrow. Dept. of Biology, Univ. of Ala. in Birmingham, Birmingham, AL 35294. Barry A. Vittor. Barry A. Vittor and Assoc., Inc., Mobile, AL 36609.

The estuarine hydrozoan, Bimeria tunicata (Syn. B. franciscana), is both euryhaline and everythermal. It occurs in waters of high turbidity, in crevices or on the underside of substrate and when turbidity drops its polyps disappear or regress. Laboratory experiments with varied light intensity and quality demonstrated that B. tunicata expanded in response to blue light (490 nm) and the response was linear with intensity. In red light, 650 ergs/cm^2/sec and 162 ergs/cm^2/sec, the response was comparable to, but less than, the response to blue light. There was an inverse relationship between the reaction time and light intensity for all intensities of blue light and for the two lower intensities of red light. Reaction time was slowest at the highest intensity of red light (2600 ergs/cm^2/sec) and there was some expansion followed by contraction. This suggests that light is significant in the behavior and survival of B. tunicata and that turbid waters are essential for the success of this species as they modify the quality and intensity of light reaching the settling sites.

THE ONTOGENY OF PREY-CAPTURE BEHAVIORS OF THE EUROPEAN FERRET. R. Steven Marshall, Dept. Zoology-Entomology, Auburn University, AL 36849

ABSTRACT - Prey-capture behaviors exhibited by a population of four European ferrets (Mustella putorius) were experimentally tested in the laboratory. Cotton rats (Sigmodon hispidus) were chosen as the prey species and experimental encounters with ferrets were conducted on a weekly basis. During the course of 40 trials, ferrets showed a decrease in: 1) the number of bites needed to kill their prey, 2) the number of adjustments of bites, and 3) the number of times the prey escaped from the ferret's grasp. Placement of the killing bite during the later trials was always on the side of the neck or head, as opposed to the early trials in which the killing bite was randomly placed elsewhere on the body of the rat. Female ferrets used their forepaws with consistency throughout the ten trials to pin their prey to the ground but male subjects never used their forepaws after trial number five. No ferret ever failed to chase a rat on the run, or to attempt to grasp it. Financial support was acquired by Dr. Don Ingold, East Texas State University, through a faculty research grant and laboratory facilities were provided by the Biology department of East Texas State University, Commerce, TX 75428.

WATERFOWL POPULATION STUDIES AT WHEELER NATIONAL WILDLIFE REFUGE, DECATUR, ALABAMA. <u>Patricia Jones</u>, Calhoun State Community College, P. O. Box 2216, Decatur, AL 35602.

Wheeler National Wildlife Refuge is located in North Alabama and extends from Decatur to Huntsville along the Tennessee River. This Refuge, Alabama's oldest and largest, was established in 1938 to determine whether or not water impoundments could be made attractive to waterfowl. Each winter thousands of ducks and geese migrate to this area. This study included comparisons of the numbers of ducks and geese from monthly refuge records during the past five winters. Comparisons of geese and duck populations were made on a month-by-month, winter-by-winter basis. A literature review of weather conditions, availability of food and potential productivity was also conducted.

Significant decreases in total waterfowl numbers from year to year generally correlate with droughts or poor food-growing seasons in the north. Significant decreases were experienced in 1981 due to a record drought. Increases or decreases in duck populations did not necessarily coincide with fluctuations in total geese populations during these years. Rare and unusual species found at Wheeler during these years were listed in <u>American Birds</u> by bird students conducting the Christmas Bird Count.

PROVOKED AND NONPROVOKED GRAY SQUIRREL ALARM CALLS. Robert S. Lishak, Dept. of Zoology-Entomology, Auburn University, AL. 36849

Provoked and nonprovoked alarm call sequences from eastern gray squirrels (<u>Sciurus carolinensis</u>) were recorded in the field and characterized spectrographically. Four note types (kuk, quaa, modulated quaa, and modulated quaa-moan) were identified and mean note and internote interval durations were determined. Morphological and temporal characteristics of notes within each treatment group were compared and were not found to be significantly different ($P>0.05$). Note morphology and tempo do not appear to be stimulus-specific characteristics of gray squirrel alarm calls.

EFFECTS OF TILLAGE SYSTEMS ON SOYBEAN YIELD. O. A. Campbell and G. Grenade.

The effects of three different tillage systems (conventional, no till and no till subsoil) on the yield of 16 varieties were measured. This work represents the first year of three-year study.

COLLEMBOLAN FEEDING EFFECTS ON FUNGAL PROPAGULES IN SOIL AND THE
RHIZOSPHERE. E.A. Curl, R.T. Gudauskas, and C.M. Peterson, Dept. of
Botany, Plant Pathology, and Microbiology, and J.D. Harper, Dept. of
Zoology/Entomology, Auburn University, AL 36849.

Mycophagous species of soil-inhabiting Collembola (Proisotoma
minuta and Onychiurus encarpatus) ingested large numbers of chlamydo-
spores of Fusarium oxysporum f. sp. vasinfectum and conidia of
Trichoderma harzianum when the propagules on millipore filters were
buried in insect-infested soil. An insect population of 1600/kg soil
significantly reduced spore density of both fungi. Germinability of
spores recovered in insect fecal pellets also was reduced. The
insects did not ingest or destroy sclerotia of Verticillium dahliae,
Macrophomina phaseolina, or Sclerotium rolfsii, but effectively pre-
vented their development by grazing on germ tubes. When Fusarium or
Trichoderma spores were applied to roots of young cotton seedlings
and these were transplanted to sterilized soil with insects (500/ 140 g
soil), the rhizosphere populations of spores were drastically reduced.
Also, insects placed in tubes of non-sterilized field soil with cotton
seedlings altered the R/S (rhizosphere soil/nonrhizosphere soil) ratio
of the natural mycoflora population from $R^O/S^O = 2.40$ to $R^C/S^C = 0.41$
(o = no insects; c = Collembola), thus reflecting a reversal of the
usually expected fungal density at the soil-root interface.

ELECTRONIC ENVIRONMENTAL DATA COLLECTION: A SUMMARY. John Deighan
and T. P. Mack, Dept. of Zoology-Entomology, Auburn Univ., Auburn, AL
36849.

The recording of environmental variables such as temperature and
humidity under field conditions is important for the development of
insect population simulation models. The use of a DATAPOD electronic
sensor/recorder (manufactured by Omnidata International) is more reli-
able than the traditional hygrothermograph, and the data can be quickly
and easily transferred to a computer for statistical analysis. A
DATAPOD recorder can sample and record over 1000 temperature and
humidity values and the recording interval can be set from 1 minute to
24 hours.
An initial investment of ca. $1500 is required for equipment to
transfer the data to a computer and erase the data storage modules
for reuse once the data has been transferred. Individual DATAPOD units
with a field shelter and probes cost ca. $1000, and depending on the
two probes selected can measure and record variables such as air
temperature, relative humidity, soil temperature, soil moisture, rain-
fall, wind speed, solar radiation, and leaf wetness. The use of a
portable micro-computer, e.g. Radio Shack Model 100, facilitates the
transfer of data, and a BASIC computer program has been written to
perform this task for this model of micro-computer.

PHARMACOLOGICAL CHARACTERIZATION OF A SERIES OF NOVEL
2,4-DIAMINOQUINAZOLINES. Thomas N. Riley and Maynard E. Hamrick,
School of Pharmacy, Auburn University, Auburn University, AL 36849 and
Jane Millen and I. W. Waters, School of Pharmacy, University of Mississippi,
University, MS 38677

A variety of human disorders such as reversible obstructive airways disease
are related to tissue levels of cyclic adenosine monophosphate (cAMP). Cellular
cAMP is formed via the action of adenylate cyclase on its substrate ATP and
is degraded to 5'-AMP via the action of phosphodiesterase. Both enzymes
have been the target of numerous pharmacological agents as a means of
modifying intracellular concentrations of cAMP and, hence, to achieve a specific
therapeutic response. In this connection, we have designed, prepared and
evaluated a series of structurally novel 2,4-diaminoquinazolines as potential
inhibitors of phosphodiesterase. The target compounds of this research have
been evaluated for their potency and kinetics of phosphodiesterase inhibition.
An attempt has been made to relate phosphodiesterase inhibition by these
compounds to a tissue response, namely, relaxation of isolated tracheal smooth
muscle. The results of the enzyme inhibition study and isolated tissue study
will be described.

ANALYSIS OF CELLULAR PROLIFERATION KINETICS USING THE BrdU-HOECHST
TECHNIQUE. Sheila D. Thomas and V. B. Richardson, Department of
Biology, Tuskegee Institute, AL 36088.

Preliminary observations of mammalian cells treated with methyl
acetimidate (MAI), a lysine-specific crosslinking agent, suggest
that its cytotoxicity may not be due to a cytologically detectable
genotoxic effect. Chinese hamster ovary (CHO) cells were studied
for cell cycle kinetics, sister chromatid exchanges (SCE's) and
chromosomal aberrations after they had undergone two or more
divisions in the presence of 5-bromo-2-deoxyuridine (BrdU). Cells
in culture were exposed to ten-fold increases in the concentration
of MAI ranging from 0.025 to 25 μM. MAI-treated cultures showed an
increase in the frequency of SCE's but the effect was not
dose-dependent. Analysis of cellular proliferation kinetics by the
BrdU-H33258 procedure revealed that MAI produced a marked mitotic
inhibitory effect as well as associated cell kinetic changes. This
inhibitory effect effect was observed as an accummulation of cells
that had undergone only two replications after 36 hours in culture.
The absence of significant increases in MAI-induced SCE's suggests
that MAI may require metabolic activation before it exerts its
clastogenic effects.

ENVELOPE PROTEINS OF <u>SALMONELLA</u> <u>TYPHIMURIUM</u>. <u>Shiva</u> <u>P.</u> <u>Singh</u> and
G.R. Wanogho, Dept. of Biology, Alabama State Univ., Montgomery, AL
36195.

Salmonella typhimurium strain TA1857 (LT-2, wild type) cells were
grown aerobically at 37°C in morpholinopropane sulfonic acid-buffered
("MOPS") medium supplemented with glucose as carbon source. Cells
harvested from late log phase of the growth cycle were lysed by soni-
cation. The envelope was subsequently isolated by several cycles of
low (12,000 x g) and high (100,000 x g) speed centrifugations. The
purified envelope was solubilized in sodium dodecyl sulfate (SDS)-urea-
NP_{40} mix and separated by isoelectric focusing in the first dimension;
electrophoresis in the presence of SDS separated proteins by molecular
weight (MW) in the second dimension. Approximately 65-70 individual
polypeptides ranging in MW from 11,000 to 93,000 daltons were resolved
in S. typhimurium envelope. Majority of the envelope proteins were
acidic in nature, being focused at a pH gradient of 4.5 to 6.5. There
were approximately 10 major polypeptides in S. typhimurium envelope.
Three of the most abundant polypeptides had MW of 51,000, 38,000, and
37,000 daltons. Molecular weight and isoelectric points of some of the
major polypeptides were similar to those of S. typhimurium "heat-modi-
fiable" protein and porins reported in the literature.

CHEMISTRY

POST COLUMN REACTION RATE MEASUREMENTS TO DETERMINE ISOENZYME PRO-
FILES. E. Clifford Toren, Jr. and Dorothy N. Vacik, Univ. of South
Alabama Medical Center, Dept. of Pathology, Mobile, AL 36617

To analyze isoenzymes, different proteins that catalyze the same
reaction, they must first be separated followed by quantitation of
each isoenzyme. They have been determined by electrophoresis, column
chromatography, and recently, by immunoassays. Isoenzymes occur in
trace quantities in serum; however, the measurement can be "amplified"
by following the reaction that they catalyze. The recent development
of incompressible anion exchangers has enabled the separation by HPLC;
however direct detection is not possible and the column effluent must
be mixed with substrates to monitor kinetically the appearance of
product in a post-column reactor. Many compounds that appear in
biological samples interfere by absorbing or fluorescencing similarly
to the product. This paper describes a two-detector PCR that corrects
for these interferences in the PCR. Work supported in part by grant
CHE8101123 from the National Science Foundation.

DETERMINATION OF LEAD IN THE AIR BY A CHEMILUMINESCENCE METHOD.
Thomas Pierce, Department of Chemistry, University of North Alabama,
Florence, AL 35632.

The determination of lead in air poses a significant hurdle to
improvements in occupational and environmental health. Particularly
needed is a means for the "real time" determination of lead in air.
At this point, this work is strictly developmental and cannot claim
to be an improvement over such methods of lead detection as atomic
absorption spectrophotometry and various colorimetric methods.

Chemiluminescent methods are noted for their sensitivity and have
acquired considerable use in the air pollution field (Fox, D.F. and
Jeffries, H.E., Anal. Chem. 51, 22R (1979). Much of the chemilum-
inescence literature has originated in Russia and a group of Russian
scientists recently published information pertaining to the deter-
mination of lead in air (Dubovenko, L.I., Shvydak, N.V., and Lenets,
V.T., Ukr. Khim. Zhurn. 48, 1294 (1982)). Our work focusses on the
adaptation of this method to industrial hygiene, as opposed to
ambient air, samples. Interferences, pH optimization, and relative
concentrations of lucinogen are discussed.

The experimental system consists of lucigenin (bis-N-methyl-
acridinium nitrate, $C_{28}H_{22}O_6N_4$), an alkaline solution of hydrogen
peroxide, and the lead ion being measured.

IMMOBILIZED-ENZYME REACTORS FOR ANALYTICAL APPLICATIONS. Moore U.
Asouzu, Mat H. Ho, Dept. of Chemistry, Univ. of Ala., Birmingham, Al
35294.

Enzymes are biological catalysts which speed-up a desired reaction
relative to an undesired one. They are specific with respect to the
substrates they act upon. This specificity is often exploited as an
advantage in the analysis of substrates in complex biological systems
such as blood. The usefulness of an enzyme as a reagent depends on the
cost of the enzyme, and its long-time stability. Both of these factors
are often overcome by immobilizing the enzyme onto a suitable support.
In this presentation, the design and optimization of an immobilized-
enzyme reactor will be described. The enzyme was immobilized on
chemically-modified Controlled-Pore-Glass (CPG). The reactor was
employed in the Flow Injection Analysis of glucose. Characteristics
of the system such as the linear range, detection limit, precision,
and selectivity will also be described. For the determination of
glucose by Flow Injection Analysis, reaction progress was followed
amperometrically.

NMR (C-13 AND P-31) STUDIES OF AMINOPHOSPHONIUM SALTS. <u>Larry K. Krannich</u> , Ravindra K. Kanjolia, and Charles L. Watkins, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

R_3P reacts with NR'R"Cl to give good yields of a homologous series of aminophosphonium chlorides, $[R_3NR'R"]Cl$, in which R = Me, Et, n-Pr, and Ph; R' and/or R" = H, Me. These compounds have been characterized using multinuclear NMR. Quaternization of the phosphorus atom to give a phosphonium ion produces a downward shift of all P-31 chemical shifts, an upfield shift of C-13 chemical shifts, a large increase in J(PC), and a large increase in J(PCH). The order of magnitude of P-31 chemical shift difference is dependent upon R for any given -NR'R". This can be correlated with the P-31 chemical shifts of the parent phosphines, the bond angle changes that result upon quaternization of the phosphorus, and the $\alpha-$ and $\beta-$ effects that successive lengthening of the carbon chain has on the phosphorus atom. The magnitude of downfield shift is also dependent on the nature of R' and R".

The magnitudes of one-, two-, and three-bond P-C coupling constants are dependent upon the nature of R, R', and R" and can be discussed relative to their effects on the percent s character in the P-C and P-N bonds. Trends in the C-13 chemical shift data indicate that intrachain $\alpha-$ and $\beta-$effects and interchain $\gamma-$effects are present. All the NMR data suggest that no multiple bonding exists in the P-N bond in these compounds.

OXIDATION OF ALKENES IN A WATER-PHOTOLYSIS SYSTEM. Thomas R. Webb and Chee-Kai Tan, Dept. of Chemistry, Auburn University, AL 36849.

Manganese (III) complexes of Schiff bases and bipyridine-type ligands are efficient catalysts for the photolytic oxidation of water in a system p-benzoquinone-Mn (III) complex-water. Addition of an alkene reduces the oxygen yield; oxidation of the alkene is observed. Oxidation of cyclohexene forms several allylic oxidation and coupling products (cyclohexenol, cyclohexenone, bicyclohexenyl, and cyclohexenyl ether) and cyclohexanediol. Relative yields of products depend on the Mn complex used; addition of catalytic amounts of solid RuO_2 also affects the relative yield of products. Mechanisms of formation of these products will be discussed.

SYNTHESIS AND CHARACTERIZATION OF DERIVATIVES OF TOLUENETRICARBONYL-
CHROMIUM.

Christopher A.L. Mahaffy, Auburn University at Montgomery, Montgomery,
Alabama 36193

The synthesis of a large number of complexes which are derivatives
of toluenetricarbonylchromium have been accomplished using a previous-
ly published technique. [References a,b]

$$\text{Arene} + Cr(CO)_6 \xrightarrow[\substack{\text{simple reflux} \\ \text{under } N_2 \quad 20 \text{ hours}}]{\text{THF: n-Bu}_2\text{O}::1:10} \text{Arene } Cr(CO)_3 + 3CO$$
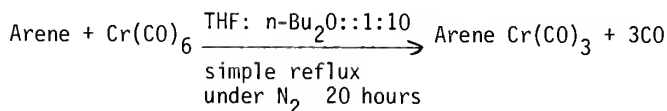
The utility of the synthesis will be discussed with particular
reference to the limits of the electron donating or withdrawing
capability of the groups which may be attached to the aromatic ring.

References

a) C.A.L. Mahaffy and P. L. Pauson, Inorg. Syn. 19, 1978, 154.
b) C.A.L. Mahaffy, Journal of Organometallic Chemistry, 1984, in press.

THE CHARACTERIZATION OF Cr(III) NUCLEOTIDES.
J. Rawlings, Dept. of Chemistry, Auburn U. at Montgomery, Montgomery,
Al. 36193.

Kinases require either the magnesium complex of adenosine triphos-
phate (MgATP) or adenosine diphosphate (MgADP) to function. However,
since these complexes are so labile, they cannot be adequately charac-
terized. By using chromium(III) or cobalt(III) as the metal, substitu-
tion inert complexes of the nucleotides can be prepared and character-
ized. The triammine complexes of chromium and cobalt with ATP and ADP
were synthesized, characterized by their UV, CD, and NMR spectra, and
then studied for their ability to react with hexokinase and creatine
kinase. The α,β-bidentate $Cr(NH_3)_3(H_2O)$ ADP complex was a competitive
inhibitor of creatine kinase. K_{is} and K_m values as a function of pH
were obtained, indicating that the metal nucleotide binding to the
enzyme is strongest at lower pH. A pK of 6.4 is associated with the
acid-base catalyst of the enzyme, which is thought to be a histidine.
The bidentate $Cr(NH_3)_3(H_2O)$ ATP complex can act as a substrate for
hexokinase, with multiple turnovers occurring. The $Co(NH_3)_3$ ATP
complex however, is tridentate and not a substrate or an inhibitor.

GEOLOGY

PETROGENESIS OF THE FARMVILLE GRANITE. Steven G. Knight and James R. Burnell, Jr., Dept. of Geology, Auburn University, AL 36849.

The Farmville granite (FG) is exposed in northern Lee County, Alabama, and intrudes the Loachapoka and Auburn formations of the Opelika Complex. The granite is moderately to well foliated with large (3x3 cm) pink feldspar porphyroblasts and a medium- to coarse-grained texture. Mineralogy is dominated by quartz, perthite and microcline with lesser amounts of plagioclase, biotite, muscovite and accessory apatite, allanite, sphene and opaques. Samples representing both FG proper and granitic segregations (GS) in the enclosing migmatitic country rock have been analyzed for major and selected trace elements to determine if any genetic relationships exists. Major element analyses of the FG are virtually identical to average alkali granite as SiO_2 averages 73% and the average K_2O/Na_2O ratio is 1.5. The only notable difference is the CaO content of the FG is uniformly higher (1.1 vs 0.7%). Although the major element analyses of the GS are very similar to the FG analyses, they display a broader range of compositional variation. Trace element data show the FG to be slightly enriched in Rb (177 ppm) and slightly depleted in Sr (118 ppm) and in Ba (530 ppm) with respect to the GS (144 ppm Rb; 178 ppm Sr; 328 ppm Ba). Therefore, it appears that the FG was derived at depth within the Opelika Complex. The FG may owe its present structural position to the combined effects of relatively minor injection coupled with significant tectonic mobilization.

CHANGES IN THE ALABAMA COASTLINE. George M. Lamb, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688.

That part of the Alabama Coastline around the entrance to Perdido Bay, called Perdido Pass, has undergone very rapid change during the past 150 years. This change is graphically illustrated on the maps of the area that have been produced by the U.S. Army Corps of Engineers, and the U.S. Coast and Geodetic Survey. The maps show a general, and steady, westward migration of Perdido Pass, and the accompanying growth of a sand spit, or peninsula, now known as Perdido Key, but formerly called Florida Point. Of especial interest are the influence of man-made changes along this portion of the coastline. Measurements from the Corps of Engineers show that an average of 165,000 cubic yards of sand was being added to the westward end of Perdido Key during the twenty year period from 1934 to 1953. Shortly after 1953, the pass was stabilized, and this growth was essentially halted by the construction of protective structure in the pass, and a bridge was built over the pass. While the coastline is stabilized now, future events, such as those that can be seen during the historical period covered, can change this rapidly.

COMPUTER-AIDED DESIGN OF GEOLOGIC CROSS SECTIONS. Steven I. Usdansky
and Richard H. Groshong, Jr., Department of Geology, The University of
Alabama, University, Alabama 35486.

A geologic cross section drawing algorithm has been developed for
a digital computer. The algorithm is based on the field observation
that folded sedimentary beds frequently consist of domains of nearly
constant dip separated by sharp hinges. This algorithm uses the
following geometric constraints: (1) each bed maintains constant
thickness; (2) a dip domain consists of a series of parallel straight-
line segments; (3) fold hinges are formed by the intersections of bed
segments in adjacent dip domains; and (4) axial surface traces bisect
the angle between two segments of the same bed in adjacent dip
domains. A smooth curve can be approximated as a series of dip
domains separated by small dip changes; thus cross sections similar to
those produced by the method of Busk may be generated. Input to the
program consists of the geometry of one bedding surface; this surface
is then propagated up and down section by the computer. Intersection
of adjacent axial surfaces within a propagating cross-section results
in the elimination of those two axial surfaces and the enclosed dip
domain, and the initiation of a new axial surface bisecting the newly-
juxtaposed dip domains. Bed segments of zero length separating
parallel dip domains indicate the presence of a detachment surface
within the cross section. A preliminary version of this algorithm
which generates geologically reasonable cross sections has been
implemented on an Apple II Plus with 64K RAM and a Z-80 auxillary
processor.

PRELIMINARY REPORT ON A JUVENILE MOSASAUR FROM GREEN COUNTY, ALABAMA.
Mary Amy Sheldon, Rt. 1, Box 35 Summerdale, AL   36580. Gordon Bell,
Jr., Red Mountain Museum, Birmingham, AL.

Descriptive information on juvenile mosasaurs is unreported in
paleonotological literature. A juvenile specimen was collected from
the Mooreville Chalk, Selma Group, of the Upper Cretaceous Greene
County, Alabama. The fragmentary specimen (RMM 2476) consists of
numerous disarticulated skull, axial, and appendicular elements.
Incomplete ossification of the postcranial elements demonstrate that
the specimen is a very immature individual not a smaller species.
Based on the elements of the skull and postcranial skeleton, the
estimated length of the skull is 12.8 cm. and the overall length of
the juvenile is 106.6 cm. Morphology of the skull, primarily the
nature of the premaxilla with respect to its articulation with the
maxilla and the formation of the external naris identifies the
juvenile as Clidastes sp. After further study, this specimen will
yield primary descriptive information concerning the young of these
marine lizards.

Abstracts

BIOSTRATIGRAPHIC IMPLICATIONS OF AN ORGANIC
BUILDUP FROM LANGSTON GAP, ALABAMA

Michael A. Gibson. Dept, of Geology, Auburn University, AL 36849.

A road cut at Langston Gap, Alabama (Langston 7.5' quadrangle, T.6S., R.5E., Sec. 12, NE-1/4, SW-1/4), exposes thinly-bedded shales overlain by a conglomeratic sandstone characteristic of the Lower Pennsylvanian Pottsville Formation. Lycopod logs preserved near the base of the sandstone lithofacies and laterally equivalent coalified-compression floras indicate an Early Pennsylvanian age for the sandstone. Underlying the sandstone is a shale lithofacies containing only unidentifiable plant and very rare invertebrate fragments and, presently, is not datable. Underlying the shale lithofacies are gray, tan, and green fossiliferous claystone, sandstone, and bioclastic limestone lenses. A slight angular relationship exists between these lower lithofacies and the overlying shaley lithofacies. The lower portion of the exposure grades laterally from claystones to bioclastic sandstones and limestones. Vertically, the claystone grades to a siltstone. The lower exposure represents an organic buildup with a fine-grained core characterized by in situ Archimedes, Fenestella, Polypora, Pentremites, Leptodesma, Spiriferina, Linoproductus, and Ditymopyge. The coarse grained flanks are composed of debris derived from the core. The sedimentology and paleontology of the lower portion of the exposure is suggestive of the Pennington Formation; the invertebrate fauna is Late Mississippian. This exposure is significant because it may offer evidence for the Mississippian-Pennsylvanian boundary in northeastern Alabama based upon both macrofloral and macrofaunal evidence.

FORESTRY, GEOGRAPHY, CONSERVATION, AND PLANNING

APPLICATION OF PRECISION TEACHING TECHNIQUES TO INTRODUCTORY Geomorphology. Howard G. Johnson, Dept. of Geography, Jacksonville State U., Jacksonville, AL 36265

In the study of geomorphology, hundreds of terms are used to describe landscape features and landform-shaping processes. Students who fail to master this extensive vocabulary often have difficulty discussing concepts and recognizing landforms on topographic maps. To encourage mastery of vocabulary, an introductory geomorphology course was restructured using micro computers for vocabulary drill and testing. All terms for the course were entered as multiple choice questions grouped by chapter. Students used the computers for drill and vocabulary exams consisting of up to 45 questions chosen at random from the test pool. Performance of 70% correct at 10 correct responses per minute was required to procede to new material. Performance on lecture and lab exams improved dramatically as a result of this emphasis on vocabulary. Even the weakest students achieved measurably improved performances without lowering standards for the most advanced students.

Abstracts

Science and Public Policy: The AAS And Farmland Protection. H.A.Henderson
and Steven R. Sax,   Muscle Shoals, Al.35660.

The use of science for shaping public policy has seldom either been
denied or well understood. An association of science activity and at-
tempts to shape public policy concerning farmland protection seems close
enough to suspect a cause - effect relationship.
     Since 1974, at least 67 abstracts in the July Journals have addressed
topics somewhat related to public policy of protecting farmland from con-
version to other uses - at least 16 specifically addressed issues some-
where in the discussion. A Committee on Science and Public Policy has been
active since 1976. Specific resolutions on the issue were passed by one
section in 1982 and by the Executive Committee in 1983.
     Few of the abstracts attempted to directly influence policy. Never-
theless, other actions intended to influence public policy immediately
followed. Sister professional societies including the Alabama Chapter of
Soil Conservation Society and American Planners Association were more
directly involved. They used materials presented inAcademy meetings and
several(including the authors) who were present in the Academy meetings
also participated in the other societies. Further, Academy presented
materials found their way into public agencies through many - often cir-
curtous routes and were used by citizen organizations in at least attempts
to influence both general policy positions and specific actions of several
public agencies.
     While the authors did not empirically test the significance of the in-
fluence of the Academy on public policy, we state the hypothesis: The
Alabama Academy of Science has had a positive role in forming public policy
to protect farmland from conversion. That role has been to assemble,
interpret and clarify relationships within both the social and natural
sciences which influenced public policy decisions.

COUNTY BUSINESS PATTERNS FOR ALABAMA. Victoria L. Rivizzigno,
Department of Geology and Geography, University of South Alabama,
Mobile, Alabama 36688.

     The analysis of selected county business patterns for Alabama
focuses upon the county wide spatial distributions of the number of
establishments for ten major standard industrial classifications.
The ten classifications are: agricultural services, forestry, and
fisheries; mining; contract construction; manufacturing; transporta-
tion, and other public utilities; wholesale trade; retail trade;
finance, insurance, and real estate; services; and nonclassifiable
establishments. The spatial patterns that emerge focus upon the
difference between highly urbanized counties such as Jefferson and
Mobile and rural counties such as Wilcox and Clay.

LIGNITE AS A SOURCE OF ENERGY. Wilbur B. De Vall, President, Proxy
Services, Auburn, AL 36830.

Part of Alabama's future mineral activity probably will be the
development of lignite for commercial use. Lignite, which is a low-
rank, high-moisture coal ranks somewhere between bituminous coal and
peat. Its occurrence in Alabama is limited to a belt extending south-
east to northwest across the southern third of the State or from parts
of Barbour and Henry counties on the east to portions of Choctaw and
Sumter at the western extremity in Alabama. Eight additional counties
also support deposits of this energy material. The south Alabama lig-
nite belt includes outcroppings of the Midway and Wilcox groups, which
are names given to the recognized deposits. Estimates place the amount
of lignite in these deposits at two billion short tons of near-surface
lignite or about 20 per cent of the lignite in the Southeastern United
States. While lignite deposits are known in Montana, North Dakota,
Texas, Arkansas, Louisiana, Mississippi, and Tennessee, those in this
state represent a reserve and undeveloped resource. Two imminent
opportunities for development of Alabama's lignite reserve include
gasification to produce methane or other synthetic gases and direct
combustion for steam generation of electricity. Based on costs at the
mouth of the mine as compared to costs including transportation for
higher-grade midwestern coal, lignite costs about 25 per cent less per
BTU than the higher grade of coal. Direct combustion power generation,
using lignite, is only slightly less efficient than using higher grade
coal. Lignite could be a more cost-effective fuel. Lignite is a fuel
source in eastern Texas, Arkansas, Louisiana and Mississippi as well as
in Western Germany and South Africa.

THE LUNA EXPEDITION IN SOUTHERN ALABAMA. M. Ann Taggart, Department
of Geography, University of South Alabama, Mobile, AL 36688.

There are four geographical controversies concerning the routes
and settlements of the Tristan de Luna expedition of 1559 to 1560.
Descriptions from primary sources are used in an attempt to clarify
the locations of: 1) Bahia Filipina, where the expedition first
landed on the Gulf Coast, 2) the port of Ochuse, where the initial
settlement was made, 3) Nanipacana, an Indian village where most of
the expedition spent the winter of 1559-1560, and 4) Cosa, a rich
Indian town according to Hernando de Soto, which was located by
Luna's soldiers but found to be poor. Many of the possible sites of
this expedition are now endangered by modern construction and
development.

RECREATION DEVELOPMENT IN CENTRAL ALABAMA. Jeffrey P. Richetto, Dept.
of Geography, The University of Alabama, James D. Barnard, Dept. of
Geography, The University of Alabama and Timothy E. Barnes, Dept. of
Geography, The University of Alabama, University, AL 35486.

Tourism is an industry that can sustain a region when other
elements of the economy are in decline. And, similar to other in-
dustries tourism requires careful planning and an environment wherein
to develop. The State of Alabama is richly endowed with sites of
natural beauty and historical significance and, therefore, has the
potential for becoming a major tourist area. Until recently, however,
Alabama has not exploited its recreational potential. It is within
this context that this study develops a trace, The Cahaba Trace, that
would not only increase tourism and the preservation of environ-
mentally-sensitive lands in the central portion of Alabama but at the
same time raise the economic base of those counties through which the
trace traverses. The trace is conceptualized as two phases including
the delineation of the trace's route system, identification of
historical and recreational activities along the route system, the
placement of descriptive markers along the trace, the development of
nature trails along the Cahawba River and the construction of new and
the widening of existing secondary roads departing from the trace's
mainline route. Counties falling within the study area extend from
Jefferson in the north to Montgomery in the south and include
Autauga, Bibb, Chilton, Dallas, Lowndes and Perry.

SUPPLYING THE CALIFORNIA GOLD RUSH: 1848-1854. Lary M. Dilsaver,
Dept. of Geology and Geography, University of South Alabama, Mobile,
AL 36688.

Upon discovery of gold in California, tens of thousands of would-
be miners flocked to the region, overwhelming its agricultural re-
sources. Two groups of regions subsequently provided foodstuffs to
the 250,000 newcomers. One group included areas such as China, Chile
and the eastern United States. Owing to great distance they provided
a small share of the foodstuffs. The second, closer group consisted
of Hawaii, Oregon, and California itself. These areas competed for
supply of all types of food products. Leadership shifted from Hawaii
to Oregon and later to California as each progressively closer region
became capable of meeting the demand.

PRINCIPAL COMPONENTS ANALYSIS OF VISIBILITY.   Oskar M. Essenwanger,
US Army Missile Command, Redstone Arsenal, AL 35898.

Visibility is one of the most complex elements of meteorological
observations. It is a function of micro-, meso-, and macro-scale
processes. In addition, its frequency distribution is non-Gaussian.
Thus an analysis of the contribution of individual factors is not
trivial. As a first attempt, a principal component analysis was made
by utilizing a logarithmic transformation of visibility. This first
study was limited to pressure (macro-scale), temperature, and wind
(meso-micro-scale). Frankfurt (Federal Republic of Germany) served
as a pilot station. As expected, the first phase of the analysis
(calculating eigenvalues and eigenvectors of a correlation matrix)
resulted in a first factor which proved to be a mixture of several
of the elements, although their weight fluctuated seasonally.   In
order to obtain simple structure as defined by Thurstone, an ortho-
normal rotation was performed. This simple rotation was sufficient
to delineate individual factors related to one element only.   At
first it was expected that the moisture content and the temperature
would be dominant factors. Surprisingly, this was not the case in
all months. However, in most months pressure was a strong factor.
The complexity of the processes affecting visibility was indicated
by the result that the first factors accounted for only between 33
to 51% of the variance. In some months two or three factors appeared
with almost equal weight. This confirms that visibility is affected
by a mixture of processes rather than a single dominant factor.

VEGETATION CHANGES IN A GRASSLANDS-FOOTHILLS ECOTONE SITE NEAR
BOULDER, COLORADO: THE CASE OF LONG MESA. Robert Burckhalter,
Dept. of Geography, Univ. of Alabama, University, AL   35486.

Boulder County, Colorado has experienced intense vegetational
change during the past 125 years. The human impact upon vegetation
change has been outstanding but the natural changes are more diffi-
cult to document. One particular site near Boulder was studied in
1908 and again in 1948. A study of species redistribution and migra-
tion was the outcome of those two research efforts. In 1983, compar-
ative species distribution was again studied at the same location.
Though there has been intensive human impact upon the fringes of the
study area since 1948, the main body has been preserved. Emphasis
of the study has been upon human disturbance and natural vegetation
change. The results of the research have shown that the main conif-
erous species, Pinus ponderosa, has increased in numbers and advanced
eastward to lower elevations. Evidence for the eastward expansion
has been supported by a history of human disturbance, previous work
and paleoecological information which indicate that the forest zones
of west central North America may be encroaching both altitudinally
and latitudinally upon the central grasslands.

Abstracts

SPATIO–TEMPORAL ADJUSTMENTS OF THE SMALL TOWN C.B.D. David W. Weaver, Department of Geography, University of Alabama, University, AL 35486.

While the large town central business district has been under substantial economic pressures which have affected its traditional character, the attributes of centrality and invested capital have tended to perpetuate the old established locus as the geographic focal point in the city. In small towns however, urban expansion and the smaller amounts of vested capital frequently provide conditions which facilitate drastic shifts of the CBD locus over time. The scale of such temporal adjustments is tracked for the city of Northport, Alabama over the period 1830-1980. The shift of the business center from the riverfront to a modern nucleus around the city's major current highway artery is discussed.

TWO EXAMPLES OF ECONOMIC DEVELOPMENT STRATEGIES IN THE TENNESSEE VALLEY, Steven R. Sax, Philip C. Sharre, and Noland C. Williams, Tennessee Valley Authority, Muscle Shoals, Alabama   35660.

The 1933 act establishing the Tennessee Valley Authority discusses the need to improve the valley's economic conditions through local resources in relationship to national perspectives. Current agency shortages in manpower and funding has strengthened the need for local partnerships in economic development programs. The community preparedness economic development strategy process affords the local community leaders a chance to establish goals and objectives for their area and have a direct influence on their implementation. The two examples are Hendersonville, Tennessee and DeKalb County, Alabama. This paper describes the local process used in each community and provides a general discussion on the similarities. The authors intend to monitor and report the local progress in each community through additional papers to the Academy.

THE LAND NOBODY WANTED. Merilyn Osterlund, student, Dept. of Geography, Univ. of Tenn., Knoxville, Tenn 37996.

The major changes in land use that occurred in Jackson County, Alabama, from after the Civil War to 1930 are examined and explained in this paper. Fifty years after the county was opened to settlement approximately one third of the land was unclaimed, i. e., public domain. Although this land, "the land nobody wanted," was mountain land, it was the basis for the development of the timber and coal mining industries in the county. Neither of these industries caused a major economic boom in the area, but nonetheless a transfer of almost all the remaining public lands to private owners, the establishment of several small factories, and an increase in non-agricultural jobs did occur. The changes in land use were the result of local and national forces: improvement of transportation, depletion of the Northeast and Great Lakes forests, growth of the iron and steel industries in the surrounding areas, and most importantly, availability of large tracts of low cost public land.

THE EFFECT OF THE RAILROAD ON THE DISTRIBUTION OF TOBACCO
FARMERS IN VIRGINIA : 1840 - 1880. <u>Henry</u> <u>E</u>. <u>Moon</u>, <u>Jr</u>.,
Graduate Student, Department of Geography, University, AL
35486-1982.

Railroads have traditionally been viewed as pioneering
tools. This study examines the spatial effect of one rail-
road line when constructed in a well established region.
Virginia had 100 settled counties when the Richmond and
Danville Railroad was built in 1858. Before this date
tobacco farmers remained in the soil exhausted Tidewater
region because adaquate shipping facilities were not
available in the Piedmont. After the line was in place, a
majority of the farmers moved to the superior soils of
Central Virginia.

GEOGRAPHICAL USES OF AERIAL COLOR INFRARED PHOTOGRAPHY.
William R. Strong, Dept of Geography, Univ of North Alabama,
Florence, Alabama 35632

Since its development in the black and white format during the
1940's, many professions have experimented with infrared photography
and have achieved successes in analyzing a wide range of problems in
different environments. Foresters employ the technique for species
identification, tree vigor determination and insect diffusion
monitoring. Agriculturalists use it to locate plant growth problems
due to pests, irrigation and fertilizer, and geologists find that
certain rock formations yield valuable information about mineral con-
tent under the scrutiny of color infrared photography.
     Color infrared photography is a tool that geographers can also
employ at reasonable costs and at different geographic scales to
analyze spatially oriented problems. Under the National High
Altitude Program, the entire U.S.A. is being photographed and copies
can be purchased in several formats. Repetitive coverage is not
possible. However, if repetitive coverage or large scale areal views
are desired, 35mm color infrared can be employed.
     This paper focuses on experimentation done by the author using
a 35mm handheld Pentax camera with a Wratten 12 yellow filter. The
photos were taken during late summer and early fall in order to see
the contrasts before and after leaf fall. Views were taken in both
the urban and rural sectors from a Cessna 150 airplane.

PRE-COLUMBIAN CONTACTS ACROSS THE ATLANTIC

M. K. McInnish, University of North Alabama
Department of Geography, Florence, AL 35630

Christopher Columbus did not discover a New World in 1492. Contact and diffusion between the eastern Mediterranean area and Mesoamerica, occured throughout remote antiquity. Men navigated within and sailed across the Atlantic Ocean for thousands of years prior to the arrival, in the New World, of that alleged discoverer.

Men were not denied access to the sea, or imprisioned within continental limits through lack of geographic knowledge or navigational techniques. Men of the ancient world were intelligent, inventive, ingenious, and innovative. What the navigators and explorers of antiquity could accomplish, also.

The possibility of pre-Columbian contact and diffusion was argued and debated during the centuries following the Spanish conquest of the New World. Evidence, supporting the view that contact and diffusion did indeed take place between the eastern Mediterranean area and Mesoamerican, increased at mounting rate, throughout the last fifty years. Similarities and parallels, myths and legends, plus the work of archeologists and scholars all combined to contribute facts and knowledge concerning navigation and exploration between those regions, in the distant past.

This paper traces and follows some of the facts and evidence in support of the view that contact and diffusion occured between the cultures of those areas, in the long-lost, far-distant past.

PHYSICS AND MATHEMATICS

PREDICTION AND ASSIGNMENT OF THE FIR SPECTRUM OF HYDROGEN PEROXIDE,
Paul Helminger, University of South Alabama, Mobile, Alabama 36688, and Wayne C. Bowman, Frank C. Delucia, and J. K. Messer, Duke University, Durham, North Carolina 27706.*

Millimeter and submillimeter microwave studies are used to predict and assign the far-infrared (FIR) rotational-torsional spectrum of hydrogen peroxide. While the observed spectrum is made more complex by the torsional motion, a number of strong features may still be readily identified. These include several strong Q-branches which result from the contributions of many unresolved lines, and numerous small features assignable to individual P- or R-brance transitions. The FIR spectrum is successfully predicted to within experimental uncertainty for K-values beyond K = 5 by means of an analysis based on microwave data.

EXPERIMENTAL INVESTIGATION OF <u>ELECTRON CAPTURE FROM LITHIUM BY KEV RANGE PROTONS</u>.* <u>S. L. Varghese</u>, Dept. of Physics, University of South Alabama, Mobile, AL 36688. W. Waggoner and C. L. Cocke, Dept. of Physics, Kansas State University, Manhattan, KS 66502

We report measurements of single electron capture cross section by protons in the keV energy range from lithium. A fast fluorine beam from the Kansas State University tandem Van de graaff accelerator was used as the 'hammer beam' on molecular hydrogen in a secondary ion source. [1,2] Applying appropriate voltages on the extractor of the secondary ion source protons at the desired energy were obtained. These protons were passed through a resistively heated lithium oven. An electrostatic field provided by a spherical sector analyzer was used, after the lithium oven, to separate the neutrals formed from charge exchange and protons that did not participate in charge exchange. A channeltron, located after the electrostatic analyzer was used as a detector. Hence the neutrals were measured with the field on and the incident protons with the field off. Target thickness of lithium was determined by measuring the cell temperature using two chrommel - alummel thermocouples and using known pressure temperature relationships. The results from the experiment are in agreement with recent calculations from both molecular and atomic orbital expansion, as well as with older data where there is overlap.
1. C. L. Cocke, R. Dubois, T. J. Gray and E. Justiniano, IEEE Trans. Nuc. Sci, <u>NS-28</u>, 1032 (1981)
2. W. Waggoner, C. L. Cocke, S. L. Varghese and M. Stockli, Phys. Rev. A (Submitted to Physical Review)

SEISMOLOGY: DESIGN AND INSTALLATION OF A SEISMOGRAPHIC STATION AT CALHOUN STATE COMMUNITY COLLEGE, DECATUR, ALABAMA. <u>Gary M. Griner, Jr.</u>, Calhoun State Community College, P. O. Box 2216, Decatur, AL 35602.

A low-cost seismic wave detection station has been designed and constructed at Calhoun State Community College. Under the sponsorship of the college, an 8 x 8 foot building was constructed adjacent to the Science Building. Inside, two horizontal pendulum-type seismographs have been installed on a base of four inches of concrete, one oriented in a north-south direction, the other east-west. These hand-made instruments have previously been operated at another site over a two year period and are known to detect Richter magnitude 5.5 earthquakes in the North American continent and magnitude 6.0 earthquakes anywhere in the world. Typical recordings and analyses are discussed.

Abstracts

PULSED DYE LASERS FOR PHOTOCHEMISTRY
AND SPECTROSCOPY

F. J. Duarte, Department of Physics and Astronomy,
The University of Alabama, University, AL 35486

Efficient high-power narrow-linewidth pulsed dye lasers have
become commercially available in the last couple of years. This new
generation of lasers utilizes compact multiple-prism grating oscilla-
tors which can span the entire wavelength region, from the near UV to
the near IR, with linewidths $\leq$ 1GHz ($\leq$ 0.03 cm^{-1}). Here we discuss
some new advances in the design of these lasers, their physics, and
applications to molecular physics and photochemistry. In particular,
high pulse-repitition-frequency (prf) copper laser pumped dye lasers,
operating at about 10kHz, will be considered.

Applications in the area of optically pumped dimer molecular
lasers in the visible will be described in detail. Here, laser
action involving the $B^3\pi_{0u}^+ - X^1\Sigma_g^+$ electronic transition of I_2 will be
analyzed. Also, double-resonance UV-IR spectroscopy experiments in
D_2CO employing a dye laser at 365nm (using PBD dye) are described.

Most of these experiments were performed whilst the author was
with Macquarie University, Sydney. Also, the UV experiments in D_2CO
were carried out at the University of New South Wales thanks to a
post doctoral fellowship from the Australian Research Grants Scheme.

GRAPHITE STRIP RAPID ISOTHEMAL ANNEALING OF SILICIDE. K.
Daneshvar, Department of Physics, Auburn University, AL 36849.

Electrical properties and elemental migration at silicide-
semiconductor interface after various form of annealing have
been investigated. The results indicate that annealing causes
rapid formation of uniform stoichiomtric silicide via Si migra-
tion from the under layer of polysilicon. A thin stoichiometric
layer forms regardless of concentration ratio in cosputtered
silicide. Depth profile analysis of the silicon poor and
silicon reach tungsten and tantalum silicide confirms the
formation of such a layer.

RELATIVISTIC RED SHIFT EXPERIMENT LIMITATIONS. <u>F. Neff Weber</u>, Dept. of Physics, Univ. of So. Al., Mobile, AL 36688.

A description of the ultracentrifuge gravitational experiment is given. The experiment attempts to simulate the gravitational red shift, resulting from relatively small gravitational field operating relatively long distances, by an effective gravitational field of 10^7 x g produced in the ultracentrifuge operating on laser light for short distances. Definitive results from the experiment were not achieved, nor was a transverse doppler effect detectable. The present paper sets forth the reasons for these non-results and calculates the necessary experimental conditions that would be necessary to achieve results.

PRODUCTION OF ^{79m}Se AND ^{81m}Se BY NEUTRON REACTIONS WITH NATURAL SELENIUM. <u>W. T. Ying</u>, J. R. Williams and W. L. Alford, Dept. of Physics, Auburn Univ., AL 36849.

The ^{80}Se(n,2n)^{79m}Se and ^{82}Se(n,2n)^{81m}Se reaction cross section ratios have been measured at three neutron energies. Deuterons from the Auburn University Dynamitron accelerator were employed to produce neutrons through the ^{3}H(d,n)^{4}He reaction. The associated particle method was used to determine the neutron flux and a 16% Ge(Li) detector was employed to measure the activity of the irradiated samples. The ratios of the ^{82}Se(n,2n)^{81m}Se cross section to the ^{80}Se(n,2n)^{79m}Se cross section were found to be 4.93, 4.89 and 5.20 at neutron energies of 14.3, 15.4 and 16.1 MeV, respectively.

STABILITY OF COPPER SULFIDE AS A CdS–Cu$_2$S SOLAR CELL MATERIAL. <u>Sher S. Kannar</u>, Dept. of Physics, Tuskegee Institute, AL 36088. P. Mohazabi, Dept. of Mechanical Engineering, Tuskegee Institute, AL 36088.

Using an Ion Scattering Spectrometer, copper sulfide samples prepared by two different methods are studied for ion damage, extent of oxidation and change of stoichiometry in various oxygen and water vapor atmospheres. It is found that samples obtained by conversion of CdS to Cu$_2$S are more stable than those obtained by direct reaction of copper and sulfur.

CORRELATED LINEAR AND ANTILINEAR MAPPINGS IN COMPLEX 3-SPACE. Garret E. Sobczyk, Dept. of Mathematics, Spring Hill College, Mobile, AL. 36608

Introducing the notation of a correlation between a linear and an antilinear mapping on $\mathcal{V}_C$ reduces the problem of the algebraic classification of antilinear mappings to the study of linear mappings and conjugations on $\mathcal{V}_C$.

A NOTE ON PYTHAGOREAN TRIPLES Aldo Forte, Dept. of Mathematics, University of Alabama in Huntsville, Huntsville, AL 35807.

The triple of positive integers x,y,z is a Pythagorean triple if $x^2 + y^2 = z^2$. If $(x,y,z) = 1$, the Pythagorean triple is called primitive.

Using an elementary property of complex numbers, a method is given to generate primitive triples of Pythagorean numbers.

FINAL REPORT ON WILCOX COUNTY. W. L. Furman, St. Joseph Church Mobile, AL 36602.

Wilcox County schools were assisted in the Visiting Scientists Program of the Alabama Academy of Science, in the Cooperative College School Science Program at Spring Hill College and in the Career Opportunities Program.

INDUSTRY AND ECONOMICS

CAN MANAGEMENT STUDENTS INCREASE CREATIVE THINKING ABILITY THROUGH CLASSROOM INSTRUCTION? Brenda L. Massetti, Dept. of Marketing and Management, Univ. of North Ala., Florence, AL. 35632-0001.

Three control and one experimental group were investigated. The control groups received book based traditional management information, while the experimental group received creativity training along with traditional management instruction. Pretest / Post-test methodology was used to determine whether convergent and/or divergent learning occurred. Both the experimental and control groups significantly increased in convergent ability, while no change was found in divergent ability for the experimental group. Divergent ability in the control group significantly decreased.

THE CAPITAL ASSET PRICING MODEL...SOMETHING NEW? Macon Wilbourn, Dept. of Acctg. & Finance, Auburn Univ. at Montgomery, Montgomery, Alabama 36193.

The most significant contribution to financial literature in the 1960s was the development of portfolio theory. Since that time, research relating to portfolio theory and the capital asset pricing model has been pervasive to both financial management and to investments.

Subsequent concepts stressed that the risk of an individual asset should be judged in relation to its marginal contribution to the overall risk of the particular portfolio. Concurrent refinements suggested that some of the risk inherent to the individual firm was not relevant to the investor since this risk could be diversified away in the "efficient" portfolio. Total portfolio risk was thus found to be a function of the riskiness of the securities constituting the portfolio, as well as the relationship between those securities.

The modern financial vernacular utilizes such terms as "systematic" risk to signify nondiversifiable risk inherent to the system, and "unsystematic" risk that cannot be eliminated through diversifications. Historical data is used by the modern portfolio theorist to correlate the return of individual stocks to that of the market in general, and thus to project the volatility of individual stock prices over time.

This writer's objective is to review these basic building blocks of modern portfolio theory and relate the total philosophy to the much-older concepts of operating and financial leverage.

THE DEFINITION AND NATURE OF HIGH TECHNOLOGY AND THEIR IMPLICATIONS FOR THE ALABAMA ECONOMY. Chris Paul, Department of Economics and Finance, University of Alabama in Huntsville, Huntsville, Alabama 35899.

This paper investigates the nature of technology from an economic perspective and suggests a definitional meaning to the modifier, "high". It also reviews other working definitions of high technology and inventories the magnitude of employment and payroll for the state under these definitions. Finally, it proposes policy measures to improve the recruitment and creation of high technology firms in Alabama.

Abstracts

MEDIA PREFERENCES OF BLACK COLLEGE STUDENTS. Marsha D. Griffin, Department of Marketing, Alabama A & M University, Normal, AL 35762.

In order to determine the media preferences of black college students, a convenience sample of 189 units from Alabama A & M University was polled. To the extent that the sample represents A & M students and results from A & M students can be generalized to other black college students, this study yields useful information to marketers who are targeting their efforts toward this group. Although 65 percent of the respondents preferred radio stations featuring soul music, 30 percent preferred stations offering a "Top 40" format. Over 40 percent of the respondents read the newspaper at least twice weekly. The evening paper was preferred by almost threefold, and the favorite sections of the paper were the sports section and the section featuring national news. Only 8 percent indicated that the society page was their favorite section. Magazines oriented toward black consumers were fairly popular among the sample. Forty-nine percent read EBONY on a regular basis, and 64 percent said they read JET at least sometimes. Other magazines of a similar nature which are favorites include BLACK ENTERPRISE and ESSENCE. General interest magazines favored by the sample were TIME, NEWSWEEK, SPORTS ILLUSTRATED, and BUSINESS WEEK. Preferred television programs were situation comedies featuring black entertainers and night-time soap operas--especially DYNASTY. Billboard advertising could be used to reach the 46 percent of the sample who lived off-campus. The respondents indicated that they read direct mail advertising at least sometimes, and 55 percent said they order through the mail either frequently or sometimes. Preferred leisure activities include music, movies, sports, and dancing. Perhaps advertisements should feature the target group participating in these activities.

PHYSICIAN LICENSURE LEGISLATION AND THE QUALITY OF MEDICAL CARE. Chris Paul, Department of Economics and Finance, University of Alabama in Huntsville, Huntsville, Alabama 35899.

This study employs empirical measurements to address two questions concerning the nature and intent of the regulation of entry into medicine. The purpose is to determine the validity of the two competing theories of regulation; the "public" and "private" interest explanations for regulatory action. The first question concerns the particular institutional arrangements and interest group participation which led to the regulation of physicians in the United States. The second question addressed is the effect on quality of medical care resulting from the regulation of medicine. The empirical results are supportive of the "private" or economic self-interest theory of regulation.

QUALITY OF LIFE: IMPLICATIONS FOR ECONOMIC DEVELOPMENT. Kerry P. Gatlin. Dept. of Mkt., Univ. of North Ala., Florence, Al. 35632.

While most studies of economic development concentrate on manpower availability, labor cost and natural resources, the role of quality of life in a particular region or city is beginning to be recognized as an important variable in the development equation. Numerous studies purport to rank the quality of life to be found in various cities across the U.S. Factors generally include unemployment rates, climatic conditions, public spending on education, public transportation and the like. The results are frequently ratings of 'quality' based on measures of 'quantity'. This exploratory study used focus group interviews to identify factors contributing to quality of life. A three part questionnaire was then administered to a sample of highly mobile middle management personnel. The following factors were important contributors to quality of life for the sample group:
1. The local economy was strong and provided outstanding career opportunities.
2. Residents were friendly and outsiders were sought out and readily accepted into the life of the community.
3. There were ample opportunities for recreation, arts and entertainment.
Other desirable factors include climate, aesthetics, education, quality of neighborhoods and health care. Several factors frequently mentioned in other studies proved to be relatively unimportant: these included crime rate, public transportation, and degree of congestion in the area. That quality of life is an important consideration for economic development was indicated as ninety six percent of respondents stated it was an important factor in their relocation requests.

UNEMPLOYMENT IN A CONTEMPORARY MACROECONOMIC PERSPECTIVE. E.D. Chastain, Economics Department, Auburn University, Auburn, AL 36830.

Solving of economic problems is suggestive of forecasting the impact of alternative solutions. Orientation is directed to international open economy analysis, objectivity in pursuit of knowledge, effectiveness with technology and management, use of systems analysis in procedures, and psychological interrelationships, with economics in a macroeconomic perspective.

The Crux of Economic Development: The Release of Innovative-Creative Potential through the Applied Sciences of Management. <u>Walter G. O'Donnell</u>, Visiting Professor of Management, School of Admin. Science, University of Alabama - Huntsville, Huntsville, AL., 35899.

The directed evolution of economic development with increasing capital, productivity, employment, and real net incomes, is marked progressively by inventions, innovations, and integrations of creative values in excess of costs, generated by a socio-economic-cultural environment conducive to creative thinking and advances in the sciences, research, development, and technology effectively managed. Creativity, however, has been popularly, sensationally, and narrowly identified with rare, inspirational, and semi-mystical strokes of genius in the arts and sciences. These sparks of discovery originate in a socio-cultural environment of inducement and are objectified through social processes and developed by further research development and converted to useful technologies by management through the applied sciences of management. This exclusive focus on individual origins of some discoveries narrows and obscures the potentials and sources of creative innovations widely dispersed in the population, in the voluntary-discretionary aspects of all occupations, in management and its applied sciences, and enterprise. The crux of economic development can be seen in this operational-collective creativity of collaborative and institutionalized innovation. This presentation will emphasize this area of institutionalized value-creating innovations, stressing the role of management and enterprise in providing the conditions, inducements, organizational and administrative behavior, and flexible organizational designs required to release and generate creative potentials, with applications of management sciences.

RECOMMENDED IMPROVEMENTS IN CIS CURRICULA FOR SOUTHEAST BUSINESS SCHOOLS. Jim Chen and John A. Willhardt, Dept of Computer Information Systems, Alabama State University, Montgomery, AL 36195.

A survey was conducted to study the CIS and QA programs offered in the southeast AACSB accredited business schools. The findings indicate that (1) to meet the increasing high demand for CIS professionals, more business schools should try to offer the CIS programs (2) the CIS programs in most schools should be strengthened, and (3) in spite of the recent argument about the importance of Production/ Operations Management, few schools offer it. Recommended improvements include the addition of a microprocessor course, a Computer Systems Project, and Data Communications along with the elimination of the Fortran IV course and the use of Personal Computers in the Introductory course.

CONCESSION BARGAINING: ARE "GIVE-BACKS" AN ANOMALY OR JUST "GOOD-OLE" COLLECTIVE BARGAINING. <u>Dennis W. Gibson</u>, Dept. of Management and Marketing, University of Alabama, University, AL 35486

Concession bargaining describes a phenomenon in collective bargaining negotiations in which the union concedes or "gives back" to management wage, benefit, and work rules and practices that were either won through years of hard bargaining or that were deviations from the industry-wide pattern of bargaining. These "Give-Backs" were announced in some quarters as a signal of the end of collective bargaining. At the least "Give-Backs" were a change from what normally happened at the bargaining table. However, when one examines the pressures exerted on the environment in which collective bargaining takes place one can readily see that there was sufficient pressure to deviate from past practice. Specifically, grave conern over productivity, competition from foreign imports, high interest rates, and a recession that brought about a high level of unemployment exerted the necessary pressure to change the traditional bargaining patterns. In addition, the deregulation of the trucking and airline industries added a dimension of cost/price competition that was not present heretofore. A careful study of what was given back to whom, in the form of wage reductions or freezes, reductions in the number of paid holidays, and work rule changes, was almost always matched by something that management gave to unions in the bargain. The automobile contracts for example contain a number of provisions that are related to guarenteed income stream, life time job security, and quality of work life programs that the United Auto Workers have been trying to get for years. Are "Give-Backs" an anomaly? This author believes that they are just "Good-Ole" Collective bargaining.

BLACK BENEVOLENT SOCIETIES AND THE DEVELOPMENT OF BLACK INSURANCE COMPANIES IN NINETEENTH CENTURY ALABAMA. C. A. Spencer, Jr., College of Commerce and Business Administration, University, AL 35486.

Black benevolent societies and black insurance companies have played a key role in providing economic security for the blacks of Alabama in addition to making a major contribution to the economic development of the State of Alabama. Background information concerning the early black benevolent societies' formation, structure, and rise is presented. The benevolent societies were the training grounds which ultimately provided the knowledge and experience upon which the black insurance companies were founded. The black industrial insurance companies were a result of the instability of the benevolent societies. This article discusses the black benevolent societies organized in Alabama during the post-Civil-War period and traces the role they played in the evolution of Alabama's first black insurance company.

THE REJECTION OF COLLECTIVE BARGAINING AGREEMENTS IN BANKRUPTCY REOR-
GANIZATION: A MATTER OF BALANCING THE EQUITIES. Dennis W. Gibson,
Dept. of Management and Marketing, University of Alabama, University,
AL 35486

Collective bargaining in the 1980's has been characterized a series
of "Give-Backs" or concessions by the unions to management. The envi-
ronmental pressures brought about by recession, high interest rates,
foregin competition, and concern over low productivity brought a change
to the bargaining table. Upon careful study, however, one notes that
wage, benefit, and work rule "Give-Backs" by the unions were almost
always matched by job security, quality of work life, and guarenteed in-
come programs in return. In those cases where the "Give-Backs" were
not matched the company had rejected the collective bargaining agreement
under the provisions of the Federal Bankruptcy Code. The rejection of
a collective bargaining agreement under the provisions of Chapter 11 of
the Federal Bankruptcy Code, rather than the renegotiation provisions
of the National Labor Relations Act (Wagner-Conyers) brought to light
the apparent "tension" between the two statutes. A subsequent series
of court cases narrowed the issues. First, did the debter-in-posses-
sion have the authority to reject an executory contract? And, was this
contract onerous and burdonsome to the company. The appeals courts re-
manded cases back to the bankruptcy courts asking for a more complete
showing that would balance the enquities between the employees and the
owners of the company. A recent supreme court decision, however, has
apparently held that there is only one issue involved. That issue is
whether or not the debtor-in-possession is a party to the collective
bargaining contract. The supreme court says no!

PRODUCTIVITY TIED TO PROFITS. David M. Miller, Dept. of Management
Science and Statistics, Univ. of Ala., University, AL 35486.

This paper describes a system used in a large, diversified com-
pany for analyzing productivity performance. The system is "profit
robust" in that productivity performance is directly linked to growth
in profits. The approach, couched in financial language, first cal-
culates the growth or shortfall in profit beyond what it would have
been if a margin goal had been achieved, then dissects this amount
into a productivity contribution and a price recovery contribution.
The paper reviews the methodology used in this analysis, along with
the various graphical aids which have proven useful in presenting the
results of the analysis to management. Several conclusions and gene-
ral observations concerning the productivity/price recovery/profit-
ability connection as have resulted from a variety of applications are
also provided.

Abstracts

REAL EFFECTS AND PRICE EFFECTS IN THE PUBLIC/PRIVATE HEALTH
CARE SPENDING MIX. James R. Seldon and H. Dean Moberly,
Dept. of Economics, Auburn Univ. at Montgomery, AL 36193.

    Government's share of the national health care bill --
now standing at nearly one dollar in every nine of United
States GNP -- has risen from 25% to roughly 45% since 1960.
In large measure, this increase reflects the introduction
and expansion of Medicare and Medicaid programs, which now
account for ten per cent of total government spending and
which are projected to continue on their upward paths with
the aging of the nation's population. Spending on health
care now constitutes some thirteen per cent of the federal
budget, compared with less than five per cent in 1965.
State and local spending, which exceeded federal expendi-
tures by one fifth in 1960, now stands at less than one half
the federal level. Private spending on health care as a
percentage of GNP has also increased, although much less
rapidly than has public spending, and now stands some forty
per cent above its 1960 level.
    Comparisons of public and private spending shares ad-
justed for relative price changes by the ratio of the impli-
cit GNP price deflator to the medical care price index shows
little change in "real" private spending, but a trebling of
government spending, since 1960. Medicare and Medicaid pro-
grams appear to have displaced private spending by no more
than one half percentage points of GNP in their initial
stages, but more research is needed to determine the size
of the displacement effect in subsequent years.

MARKETING FINANCIAL SECRECY. Frederick A. Viohl. Department of Mar-
keting, Management, and Economics, Troy State University, Troy, AL
36082.

    Few aspects of international finance hold greater fascination than
does secrecy. Images flash through ones mind of suitcases crammed
with currency crossing national boundaries; of close-mouthed couriers
slipping easily into and out of airports; of expatriates living hand-
somely; the briber and the bribed; the violater of securities laws
squirreling away profits; the business person fleeing his/her credit-
ors; the husband fleeing his wife; the law-abiding citizen fleeing
exposure to political or economic risk. All are players in the global
financial secrecy game. Financial secrecy raises complex questions
about social conduct that cross economic, political, legal and ethical
lines. It thrives on turmoil and conflict in an environment of dark-
ness and silence that is normally closed to scholars' efforts to
identify its causes and consequences. Fortunately, the conventional
tools of business analysis, with a little imagination, can yield some
useful insights into an otherwise murky subject. Predictably, it is
all a matter of supply and demand.

CORPORATE SOCIAL RESPONSIBILITY: Minimum Criteria for Management.
Marian V. Heacock, Dept. of Management, School of Business,
Univ. of Ala. in B'ham, University Station, Birmingham, AL 35294.

     Three basic claimant groups are established as those which hold a
primary right of expectation from the firm in establishing corporate
policy which affects socially responsive behavior. These three groups
are the investors, internal employees, and target market customers.
Corporate behavior toward the investor in providing for an acceptable
level of return on investment is suggested as an internal measure for
socially responsible behavior toward the investor group. Investors
are given the responsibility of allocating net profits to society in
such a manner which will be socially responsive. An argument for the
proper criterion for profit allocation is the implementation of cor-
porate codes of ethics in stockholder decisions. Internal employees
are viewed from two areas: job satisfaction and job benefits. Pri-
mary emphasis is focused upon critical areas of need for job benefits
relative to the issues of employee privacy and protection against
unjust dismissal. Target market customers are viewed as the groups
requiring major reinforcement by existing corporate efforts to provide
social benefits. A method of achieving both corporate and social
benefit for the customer is the presentation of a micro-method of
internal targeting of goals to achieve consumer confidence. The
total focus of the paper is upon internal micro-methodology, as
opposed to external macro-methodology. This technique is implemented
for the purpose of establishing minimum criteria for management in
attaining expected performance levels which will satisfy the
perceived requirements of the basic claimant groups.

INDUSTRY SPECIFICATIONS AND MATERIALS REQUIREMENTS ARE IN
DISAGREEMENT. Albert E. Drake, Dept. of Management Science and
Statistics, University of Alabama, University, AL 35486.

     The materials and products that are being supplied some
manufacturers for subsequent use in the assembly of a finished good
are either not of sufficiently high quality or the quality is too
variable to meet contract specifications. Corrective action has led
some manufacturers to write more strict specifications and then
relaxing their acceptance standards. Other manufacturers have
required their suppliers to institute Statistical Quality Control
(SQC) procedures in their production processes in order to control
quality within reasonable boundaries. Foreign competition has pro-
vided the impetus to installation of SQC procedures in a number of
industries. Many plants have not adopted these procedures and are
experiencing quality problems and subsequent loss of markets. The
long term trend in these plants will likely result in their demise
unless they are able to produce a better quality product. The SQC
procedures will provide a method to reduce variability in quality of
some products and is a valuable aid in keeping and acquiring customers
for some products.

LIFE INSURANCE--CURRENT TRENDS. Charles D. Gulley, Dept. of
Accounting & Finance, Auburn University at Montgomery, Montgomery, AL
36193.

    The life insurance industry is no exception in that it faces many
sweeping changes. Tradition is being overturned in many areas. One
way this is observed is from the fact that the emphasis in life
insurance sales is shifting from the traditional policies such as
whole life, endowment and term policies to new adjustable type that
respond to changing needs in a changing economy. The adjustable type
policies combine total insurance flexibility with a responsive
interest rate. The policies change as your life changes. The
insurance companies are reacting to the criticism that they cannot pay
a responsive rate of interest. Most companies had a long-term
investment approach with "old" money having an average maturity of 10+
years--assets invested primarily in long-term bonds and mortgages.
The premiums generated by new policies are separated from the "old"
money and invested in a "new" money investment portfolio. The new
portfolio investments have short-term investments, typically six days
to six years maturity. These are the best vehicles considering
risk--time and safety. The results: crediting rate will be
responsive to interest rate fluctuations and more volatile than "old"
money portfolios. Professionals and business executives with rising
incomes are becoming more sophisticated in their needs and attitudes.
This emphasizes the need for competent, professional total financial
planning, which includes the proper weight for new life insurance
products.

COST REDUCTION EFFORTS: The UA/UAW/GM CASE. David M. Miller, J. M.
(Rae) Mellichamp, Dept. of Management Science & Statistics, and J.
Barry Mason, Dept. of Management and Marketing, Univ. of Ala.,
University, AL 35486.

    This paper describes the joint efforts of faculty and students
from the University of Alabama, coupled with labor and management
from a GM plant to find enough cost reductions to keep the plant from
closing down. A comprehensive search of cost savings was undertaken
that spanned areas from energy to material handling to plant security.
Over 50 projects have so far been initiated at the plant to identify
realistic means of reducing operating and support costs. These pro-
jects include integrating robots into packaging/palletizing opera-
tion, designing an aquifier system to store chilled water during the
winter for use in the summer, and developing a computerized inventory
analysis system to identify uneconomical amounts of on hand stock.
This last project has an estimated one-time savings of $420,000 and
an annual savings of over $135,000. Through project efforts such as
this, the joint UA/Labor/Management task force was able to reach its
targeted cost savings goal after only 8 months, more than two years
ahead of schedule.

Abstracts

AN ANALYSIS OF FEDERAL OFF-BUDGET EXPENDITURES. H. Dean Moberly,
Department of Economics, Auburn University at Montgomery, Montgomery,
AL 36193.

U. S. budget deficits have been a part of American life for the
past 50 years. Recently, recorded annual deficits have increased to
some $200 billion. Now, questions arise as to how these deficits can
be reduced since they are placing undue pressure on interest rates.
Should interest rates rise again, the U. S. economy would lose its
ability to continue its current expansion. No one wants to return to
the 21% prime and 18% inflation rates which characterized the economy
during the late 1970's. This study shows that the recorded budget
deficit is only the tip of the iceberg with respect to government
deficit spending. Not so well known is the off-budget borrowing
activity of Federal agencies. This borrowing occurs at the Treasury's
little-known Federal Financing Bank in Washington and amounts to about
$100 billion annual rate currently. To finance this off-budget, non-
recorded agency spending, the Federal Financing Bank (FFB) issues debt
instruments to the money markets, further increasing money demand.
Subsequently, upward pressure is placed on interest rates. Off-budget
borrowings finance such activities as housing authorities, low
interest loans to farmers, covert activities of government, etc.
Congress does not vote this spending and therefore is not held
accountable for it. The U. S. in fact has two budget deficits, both
of which are creating severe upward pressure on money demand and
interest rates.

MORE EFFECTIVE STAFF MEETINGS THROUGH BETTER PRESENTATIONS. Richard
Wiegand, Dept. of Management and Marketing, University of Alabama,
University, AL 35486.

Executives can improve the effectiveness and communication quality
of the staff meetings they oversee by having staff members who make
oral reports improve their presentation skills. The executive should
inform all who make presentations that: (1) except for extremely short
routine reports, the staff member should get a time allocation from the
executive before preparing the report; (2) all presentations should
start with conclusions and/or recommendations (unless the information
being given is negative, delicate, or sensitive); (3) the conversa-
tional approach should be used, no report should ever be read to the
group, and emphasis should be on 3x5 lecture-note cards rather than a
script; (4) the visual aids appropriate to this group and this topic
should be used; and (5) each presenter should evaluate his or her
speaking techniques to remove distractions. Handouts should be dis-
tributed as each major point is made and the handout becomes relevant,
never at the start of the talk (unless the number of persons in the
staff meeting is so large that a handout cannot be distributed in 10 or
15 seconds).

Abstracts

MICRO COMPUTER GUIDED REFINANCING DECISIONS. Steven M. Zimmerman and
William H. Walker, College of Business, Univ. of S. Ala., Mobile, AL
36688.

The objective of this paper was to address the problems of re-
financing real property and provide a micro-computer-based tool to
help determine the present value of the difference between existing
financing and potential alternatives. This study was needed because
many home owners and real estate investors have found themselves faced
with the problem of having financed at an interest rate which is sig-
nificantly higher than current market interest rates. As a result,
they must make a decision of whether or not to refinance. The answer
to their question is yes if the present value of the costs of refi-
nancing is less than the present value of the costs of maintaining the
existing financing. Determining the present values of the costs of
the financing alternatives is possible using a method demonstrated by
Walker and Henderson if their tables are available and there is suffi-
cient time. An alternative to the Walker and Henderson tables and
worksheets is to let a micro computer solve the problem. The proce-
dural form of this paper was (1) to discuss and identify the after-tax
cash flows which were analyzed; (2) to discuss and theoretically cor-
rect method of completing the analysis; and to demonstrate the use of
a program developed for the purpose of making this analysis with a
micro computer.

A COMPARATIVE STUDY OF THE BUDGETARY PROCESS OF THE COLLEGES AND UNIVERSITIES IN THE
STATE OF ALABAMA. Desta Damtew, Dept. of Accounting and Finance, and Yacob Haile
Mariam, Department of Business Administration, Alabama State University, Montgomery,
Alabama 36195.

A budget is a financial plan of organizational objectives. It is a monetary
expression of the expected short-run and long-term major activities and desired
outcomes of an institution. Accordingly, budgets have been widely accepted as
indispensable managerial tools which facilitate planning, controlling, coordination,
communication and performance evaluation functions. The importance of budgeting
has been slowly but surely recognized by institutions of higher education since the
mid-1950's. The budgetary process of the colleges and universities in the State
of Alabama is guided by a Budget Management Act of 1976. This study has attempted
to determine the extent to which the requirements of the Act are being implemented.
Information obtained from responding colleges and universities, the Finance
Department, the Department of Post Secondary Educational Services, and the Alabama
Commission on Higher Education reveal the utilization of fairly standardized
procedures and forms in the preparation and legislative review and approval phases.
On the other hand, procedures which relate to the implementation, reporting, and
post-audit phases of the budget leave a lot to be desired. Unless this aspect of
the budgetary process is also strengthened, the above stated benefits of budgeting
will not be fully realized.

Abstracts

PUBLIC AWARENESS MARKETING OF ALTERNATE ENERGY DEVICES

John W. Lortie, President and Director of Research, Energy Research Corporation, Mobile, Alabama 36604

     The alternate energy industry in America is a sleeping giant awaiting the proper stimulus to take its place among the established economic industrial forces that have placed this nation in the forefront of leadership in the free world. Due to present conditions which have produced a temporary surplus of fossil fuel, the public are lulled into a complacency that is understandably a mental block to their interest in anything that will change their accepted life style. Alternate energy sources and devices that do not fuel their cars or lawnmowers, wash the dishes, clean clothes or open cans do not interest them, even casually, until they are demonstrated in the supermarket or on television and prominently displayed in newspapers, magazines, books or anywhere that will demand their attention. However, this attitude will be their undoing when demand for fuel far exceeds the supply of present stockpiles, and unique alternate energy sources will be sought to sustain the status quo life style now enjoyed. The alternate energy sources available now include fission atomic energy, solar energy, geothermal, wind and, in the foreseeable future, fusion, low cost hydrogen and advanced efficient photovoltaics. This paper will address not the methods or fuels, but rather the marketing aspect of public education of their values.

THE USE OF TREASURY BOND FUTURES TO HEDGE A BOND PORTFOLIO

Philip Gregorowicz, Dept. of Economics, AUM Montgomery, AL

     A futures contract is a commitment to buy or sell a specified amount of some commodity at a fixed price some months away. Anyone worried about future price fluctuations adversely affecting the value of marketable assets can hedge their risk by taking offsetting positions in the futures markets.
     Futures markets embarked on a period of frenetic growth in the 1970's. This growth in both the type of contracts and in activity was spawned by the extreme interest rate volatility of the period. Large investors and financial institutions like pension funds, insurance companies, and depository intermediaries are now able to reduce the risk associated with interest rate fluctuations on their portfolio values by hedging with financial futures instruments.
     Despite their value, most potential users do not participate in financial futures due to a lack of understanding of the futures contract. This paper explains the usefulness of one financial futures instrument: Treasury bond futures. The objective is to explains the Treasury bond futures contract, its underlying relationship to the cash market instrument, and the advantages it offers to hedge a bond portfolio and thereby reduce risk.

Abstracts

SECOND CAREERS: A PARTIAL SOLUTION. <u>Benjamin B. Graves</u>, Dept. of Management and Marketing, The University of Alabama in Huntsville, Huntsville, AL 35899.

Many developed nations of the world, including the United States, are experiencing a rapidly aging population. One Japanese researcher, counting the numbers of people over 65 as aged and using 7% as the point at which a population could be considered old, concluded that Japan crossed this point in 1970. Extending the current trend to 2020, Japan would have a staggering 20% of its people over 65. The United States would be around 15% by the latter date. These trends have momentous economic, fiscal and social implications (e.g. social security and health maintenance). Still further aggravating this issue is the tendency toward early retirement among military, governmental, business and other elements of our society. This paper suggests second or even third careers hold some potential as a partial solution and cites several examples, both domestic and abroad, where both productive work and economic contribution have occurred. Notable among these is the Avanti Corp. in South Bend, Indiana, the elderly work with young children in the Peoples Republic of China, the Retired Military Officer's Association in Taiwan, the International Executive Service Corporation in the United States and the use of retired employees in Japan to smooth out the surges and dips in the work force. This enables the Japanese to promise many of its unretired employees lifetime employment.

A SIMULATION STUDY OF PRINCIPAL COMPONENT REGRESSION AND ALTERNATIVE ESTIMATORS FOR VARIANCE COMPONENT MODELS. Hui-Chuan Chen, Dept. of Computer Science, Univ. of Ala., University, AL 35486. <u>David C.Cheng</u>, Dept. of Finance and Legal Studies, Univ. of Ala., University, AL 35486.

Since the pioneering work by Balestra and Nerlove, there has been an increasing interest in the use of variance components models to pool cross-section and time series data. Due to the specification of correlated residuals, various methods are suggested to get efficient estimates. In this paper we attempt a simulation study to variance components model with two exogenous variables and put emphasis upon the multicollinearity problem which is a common pehnomenon in empirical econometric studies. In a series of simulation studies we have demonstrated that multicollinearity has significant effect on the estimates of variance components models and should be taken into account in the selection of estimation methods. From the simulation results in terms of relative MSE, it is clear that the performance of various estimators previously proposed for variance components models can be improved when combined with the principal component regression technique to alleviate the problem of multicollinearity. In particular, the Nerlove method in combination with PCR seems to be the best among all the estimators under this study.

184

ALABAMA REACTS: THE EFFECT OF CATEGORICAL VERSUS UNIVERSAL GOVERNMENT EXPENDITURE. Zena A. Seldon, Dept. of Economics, Auburn University at Montgomery, Montgomery, AL 36193.

In a recent paper (Grabbing the Whole Arm: Some thoughts on shafting the middle class, presented to the MidSouth Academy of Economists, February, 1984), the author argued that frequent use of categorical provision of social welfare goods and services routinely purchased by all income classes would systematically lower net benefits to the middle class taxpayer simultaneously increasing net benefits (decreasing net costs) to the upper class taxpayer. The frequent use of this delivery mechanism since the mid-1960's helps to explain the changes in attitude of the voting population in the US from the late 1960's to the present. In order to test this model, a survey of taxpayer attitudes was conducted in Alabama, among other places. This paper reports on the responses of the Alabama taxpayer about several governmental attitude variables, broken out by income class. As expected, the middle class taxpayer is concerned about governmental taxation and expenditure; further, as predicted, his attitudinal responses are moving toward those of the upper income voter, not only in regard to current government expenditure but toward possible future (proposed) government expenditure. Having examined the trends toward similarity, the areas, magnitudes, and significance of remaining attitudinal differences between the middle and upper income classes are examined.

EDUCATION EXPENSE DEDUCTIONS FOR PERSONAL COMPUTER OWNERS. Robert C. Lake, Mary R. Golden, and Samuel L. Lett, Dept. of Accounting & Finance, Auburn University at Montgomery, Montgomery, AL 36193.

The rapid spread of personal computers has raised significant questions concerning the Federal Income Tax deductibility of costs connected with their use in the home. This paper examines the possibility of education expense deductions related to the operation of a home computer. The Internal Revenue Code and related Regulations and Rulings do not directly address the question of home computer deductions, but an analysis of deductions allowed for possession and operation of other assets is illuminating. From such an examination, it is concluded that the use of personal computers in the home may give rise to educational expense deductions when: (1) the computer is used as a tool in the pursuit of traditional education (i.e., coursework at a school or college); (2) the computer is used as part of the teaching medium, as in Computer Assisted Instruction (CAI) or Computer-Managed Instruction (CMI); or (3) when the operation of the computer is itself an educational experience (e.g., it develops job-related computer skills). Additionally, the paper reviews the depreciation and investment credit rules as they apply to individuals claiming education expense deductions relating to personal computer usage in the home.

Abstracts

FEDERAL REGULATION OF EMPLOYMENT: WHAT BUSINESSES SHOULD KNOW ABOUT
AGE, RACE, AND SEX DISCRIMINATION. Renee D. Culverhouse, Department
of Management, School of Business, Auburn University at Montgomery,
Montgomery, Alabama 36193.

Since the mid-1960's, the federal government has been very
interested in the employment practices of private businesses. The
first piece of federal equal employment legislation to be enacted, the
Equal Pay Act of 1963, provided equal pay for equal work. Title VII
of the Civil Rights Act of 1964 outlawed discrimination in employ-
ment practices on the basis of race, color, religion, sex, or national
origin. In 1967, Congress passed the Age Discrimination in Employ-
ment Act, modeling it after Title VII, prohibiting discrimination in
employment practices on the basis of age. Employment, discharge, and
promotion (or lack of the same) have all come under close scrutiny
because of such federal legislation. Businesses have been forced to
justify their employment decisions and to prove that such decisions
have not been based in any part on an employee's age, race, or sex.
As any employer who has been challenged can tell you, that is no
small burden to bear. This paper takes a look at how the federal
government has regulated employment practices and offers some practical
solutions to dealing with the problem. It presents a discussion of the
most common theories of discrimination, the proof required in such
cases, and the defenses available to the employer.

FARMER'S MARKET PARTICIPATION STUDY, LAUDERDALE COUNTY, ALABAMA.
Gerald L. Crawford, Professor of Marketing, University of North
Alabama, Florence, AL 35632-0001. William S. Stewart, Professor of
Management, University of North Alabama, Florence, AL 35632-0001.
W. Joe Free and Veronica Free, Tennessee Valley Authority, National
Fertilizer Development Center, Muscle Shoals, AL 35660.

Small farmers face many difficulties in marketing their output of
fresh fruits and vegetables. One solution to these problems is direct
marketing to consumers. Farmer's markets represent a proven direct
marketing channel that has been beneficial to both farmers and to
consumers. An effort was undertaken to study the Florence Area
Farmer's Market. The chief objective was to obtain needed information
that would allow development of strategies that would encourage
increased use of the facility by small farmers selling their produce
and by customers purchasing these products. The researchers contacted
529 households, by telephone, in Lauderdale and Colbert Counties,
which are located in northwest, Alabama. From this random sample,
respondents were divided into "customer" and "noncustomer"
populations to determine: (1) reasons why people shop or do not shop
at the Farmer's Market, (2) products bought during various months,
(3) demographic and sociographic characteristics of both populations,
and (4) suggestions for improving the operation of the Farmer's
Market. Results of the study are included in the paper.

INITIAL IMPACT OF INCREASED OIL & GAS SEVERANCE TAX RATE ON PRODUCTION
OF OIL AND GAS AND GROSS SEVERANCE TAX COLLECTIONS IN ALABAMA:
IMPLICATIONS. <u>Keith A. Russell</u>, Dept. of Accounting, Univ. of S.
Alabama, Mobile, AL 36688. <u>William H. Walker</u>, Dept. of Finance,
Univ. of S. Alabama, Mobile, AL 36688.

In February, 1983, the state of Alabama implemented an increase
in the oil and gas severance tax rate of two percentage points. This
increase has effectively increased total tax paid by producers on
"well-head' value of oil and gas from eight to ten percent. This
study attempts to assess the impact of the increased tax on: (1) oil
and gas production; (2) severance taxes collected by the state of
Alabama from oil and gas; and (3) predictive models based on a 'before-
and-after' scenario concerning (non)implementation of the increased
tax. Multiple regression models were developed for oil and gas
production with and without the probable effect from an increased
severance tax rate. Pressure curves were developed for oil prices,
gas prices, oil prices with increased severance tax impact, gas prices
with increased severance tax impact, U.S. oil production, U.S. gas
production, Alabama oil production, and Alabama gas production. The
findings of the study strongly indicate that the increased oil and gas
severance tax rate has had an impact on oil and gas production in the
state of Alabama and that gross severance tax collections have been
affected.

SCIENCE EDUCATION

CONSTRUCTION AND UTILIZATION OF LARGE STRUCTURES IN SPACE: SPIN-OFF
STUDY FOR MIDDLE SCHOOL SCIENCE. <u>Ernest D. Riggsby</u>, Science Education,
and Dutchie S. Riggsby, Instructional Media, Columbus College, Columbus
GA. 31993-2399.

Continued success of the Space Shuttle Program and the announce-
ment by the President that a space station should be designed and
placed in orbit within the next decade, spurs a new wave of interest
in the applications of a wide range of manufacturing, industrial, and
scientific enterprises in low earth-orbit. The middle school science
unit described in this paper, mainly involved using slides, charts,
printed materials, and fabricated models of both state-of-the-art
space hardware and planned future programs, to help students consider
the scientific, technological, and economic considerations of such a
major undertaking and what some of its prospects and promises for the
future are.

Abstracts

THE RELATIONSHIPS BETWEEN COGNITIVE LEVEL, ANXIETY, MATH SKILLS, AND
NURSING STUDENT"S ABILITY TO SOLVE DRUG DOSAGE CALCULATIONS.   Ellen B.
Buckner and Myra A. Smith, School of Nursing, University of Alabama in
Birmingham.

It was noted that students enrolled in a Pharmacology in Nursing
course had difficulty in accurately computing drug dosages.   Some
students demonstrated deficits in basic math skills as well as an ina-
bility to utilize logical reasoning in problem solving.   Students
expressed the opinion that their high anxiety influenced their ability
to accurately perform the calculations.   Therefore, the purpose of
this study was to determine if relationships existed between cognitive
level, anxiety, basic math skills and the nursing student's ability to
solve drug dosage calculations.   The Speilberger Trait Anxiety Inven-
tory, Sills Test of Formal Operational Ability and a Basic Math Skills
test were administered to 84 sophomore nursing students during the
first day of class.   The Speilberger State Anxiety Inventory was given
during the Drug Dosage Calculation Exam.   The means and ranges of the
test scores were determined with wide ranges of scores being noted.
Correlation co-efficients were computed to determine association and a
regression model was evaluated utilizing the State Anxiety Inventory,
Sills Formal Operational Test and the math test as independent vari-
ables and the calculations test scores as the dependent variable.
Significant correlations were found between the math skills test and
the calculations test as well as between the cognitive level and calcu-
lations test, but not between the State Anxiety and calculations test.
The multiple regression for the three variables was significant at
p $\leq$.01 level.   Recommendations include analyzing the data in relation
to choosing and implementing teaching strategies to increase formal
operational ability and basic math skills as well as to decrease
anxiety.

MICROCOMPUTER AS A VISUAL AID, MOTIVATOR, AND MEANS OF DEVELOPING
A VOCABULARY.   D. Lee Allison, Department of Physics, University of
North Alabama, Florence, AL   35632-0001.

With increased power and compactness available in computer
graphics, it is now possible to produce better diagrams than those
most instructors can draw on the chalkboard.   An added benefit is
animation.   Because of the video game syndrome which has developed
in the United States, any well written teaching package, CAI, cast
in a game format is very effective.   Special vocabulary can be
encoded by the instructor and given to the student for testing or
drill.   These three uses of the microcomputer seem to be more
effective than more traditional methods.

COMPUTING SCIENCE WORD PROBLEMS. <u>Robert E. Rowsey</u>, Terry C. Ley, and Loren L. Henry, Dept. Curriculum & Teaching, Auburn Univ., AL 36849

One hundred fifty-two heterogeneously grouped eighth grade students, selected from two middle schools in Alabama and one middle school in Arkansas, were administered two instruments. The Mathematics Test (MT), was used to determine whether the students could carry out the required computations when no word problem was involved. The Word Problem Test (WPT) required solving six science-related word problems based on the same types of computation as appeared in the MT. The computations for WPT were actually embedded in the MT, as a cross-check. The computational skills required for solving such problems are emphasized in most current eighth grade mathematics books. Scores on the computation test suggested that the adolescents involved in this study could compute reasonably well. Slightly more than 71% of the students successfully completed at least five of the six computation tasks. Analysis of the WPT indicated that the subjects understood the literal facts of the science word problems and the special vocabulary used, and they had little difficulty identifying the tasks required for solving the problems. On the other hand, analysis of the processes students used in attempting solutions for the word problems revealed that, on the average, nearly a third of the students did not select an appropriate process. Furthermore, another 17% made no attempt to solve any given problem. The data indicated that literal comprehension and task identification are more highly correlated with problem solutions than is either vocabulary or straight computation.

COMPUTER GENERATED TESTS. <u>Raiford M. Ball</u>, Auburn High School and Dept. of Physics, Auburn Univ., AL 36849.

A computer program that generates objective based physics test has been developed. The program uses a pseudo random number generator to generate values used in specific test items. Any number of different tests can be constructed from specific objectives. This program is written in Microsoft BASIC and is adaptable to more microcomputers.

Abstracts

A COMPARISON OF INSTRUCTIONAL MODE ON THE ATTITUDE AND ACHIEVEMENT OF
FIFTH AND SIXTH GRADE STUDENTS IN SCIENCE. <u>Dale R. Rice</u>, Department
of Elementary-Early Childhood Education, University of South Alabama,
Mobile, Alabama 36688.

This study analyzed the differences in attitude and achievement
of fifth- and sixth-grade subjects presented with a series of science
lessons directed toward instructional procedures which addressed the
right hemisphere, the left hemisphere, or both hemispheric processing
modes.   The study group consisted of sixty-five (65)   randomly
selected students divided into four instructional groups. Each group,
except Group 4, which served as the control   group,   received
instruction on a unit dealing with electricity using three different
instructional modalities.   Pre- and post-test assessment of attitudes
and achievement gains were conducted for each instructional   group.
Data analysis indicated that significant gains in achievement   were
greatest in the left hemisphere, textbook approach, although this
group displayed the lowest gains in attitude. The greatest gains in
attitude occurred in the approach utilizing an integrated left-right
hemispheric approach.   This group also showed significant gains in
achievement.   The study's conclusions imply that elementary science
teachers should alter their instruction to include, along with the
textbook approach, hands-on, manipulative activities in   teaching
science.   In this way both brain processing modes can be utilized to
improve both the achievement and attitudes of students in   the
elementary science classroom.

THE ROLE OF MICROCOMPUTERS IN SCIENCE EDUCATION. Neil P. Clark, Sr.,
School of Education, Columbus College, Columbus, GA 31993.

Computers have been major scientific research tools since the 1950's.
Their effectiveness in teaching science is just now beginning to be
felt. Of the several major areas of computer application in science
education, simulation and modeling show great promise as computer-
assisted instructional tools. The microcomputer can simulate experi-
ments that cannot be performed easily or safely in the laboratory. In
this study, an attempt has been made to investigate the availability of
software as well as ways in which teachers and students can use micro-
computers to enhance students' laboratory experiences.

Abstracts

SOCIAL SCIENCES

COUNTY SUPPORT OF DISASTER PREPAREDNESS IN ALABAMA. Daniel J.
Dunmire and David W. Sink, Dept. of Political Science and Urban
Affairs, University of Alabama in Birmingham, Birmingham, AL 35294.

Alabama law mandates that each of the state's sixty-seven
county governments provide "civil defense" for residents under
its jurisdiction. Given the wide range of natural and human-caused
catastrophes to which civil defense agencies must respond, the charge
is no mean task. This paper, which draws on the results of a mail
questionnaire returned by fifty-five of the county civil defense
directors and on a series of interviews with local and state disas-
ter preparedness personnel, reports three interesting findings.
First, the mitigation of disaster potential and the preparedness
for disaster in Alabama counties both depend in part on how much
leadership is exercised by elected political leaders. Once a
disaster has occurred, however, an adequate response by civil
defense forces is associated with the adequacy of funding for that
agency. Finally, in counties which have experienced a state-declared
disaster in the past five years, the recovery task appears to be
more completely and quickly accomplished.

TELEVISION: DOES IT HAVE A ROLE IN LOCAL ELECTION CAMPAIGNS? Louise W.
Dengler, Dept. of Political Science, Univ. of South Ala., Mobile, AL
36688.

In the past thirty years the media-centered campaign has become
the standard in American elections. Television's ability to reach mass
audiences has made it ubiquitous in national and statewide campaigns.
But television's high cost has led to the view that its use is not eco-
nomic in sub-statewide elections or those not in concentrated population
centers. The purpose of this study is to test the conventional view
concerning the value of television in lower level campaigns. The focus
selected is county office election campaigns. Data was collected
through interviews with successful candidates and through a survey of
county voters. Candidates were asked how they used television and their
evaluation of its use. Candidates overwhelmingly prefer a personal cam-
paign at this office level. Voters were asked how much they rely on
television to help them make their vote decision. Voter responses show
considerable reliance on television. Voters perceive television as a
personal medium, one that enables them to know and judge candidates al-
most as well as seeing them in person. Television may be more effec-
tive in lower level campaigns than has been believed.

RESEARCH TOPIC PREFERENCES AMONG UNDERGRADUATES. William F. Vitulli
and Susan A. Hoppe, Department of Psychology, University of South
Alabama, Mobile, Alabama 36688

The nature of problems selected for research by behavioral
scientists continues to concern the public. As a measure of their
research values, 228 undergraduates were presented with a list of
17 research topics cited by Smith, Sarason, and Sarason (1982) in
their introductory text. The students ranked these topics in order
of their preference and interest for future study. Given highly
significant inter-correlations among 8 sections of undergraduate
psychology courses, pooled mean rankings resulted in the following
distribution of topics: (1) brain functioning and drug effects; (2)
genes and behavior; (3) learning and remembering; (4) child rearing
and adulthood; (5) coping with stress; (6) cause and control of
aggression; (7) prevention of mental illness; (8) self control over
behavior; (9) sleep and dream functions; (10) alcoholism: nature and
rehabilitation; (11) nature and testing of intelligence; (12) men and
women: differences and causes; (13) noise, crowding, pollution, and
behavior; (14) existence of extrasensory perception; (15) pornography
and behavior; (16) language ability in animals; (17) busing,
prejudice, and academic performance. A factor analysis was computed
on all of the individual rankings. Four factors accounted for 76.8%
of the data. The undergraduate students of the 80s appear more
eclectic in their preferences for research topics than the under-
graduate students of the 60s or 70s.

NATURALIZATION STATISTICS FOR GREEK, ITALIAN, AND TURKISH IMMIGRANTS
IN JEFFERSON COUNTY, ALABAMA, 1886 - 1911. Mary L. Shields, Dept.
of History, Univ. of Alabama, Birmingham, AL 35294.

Of the 2,365 immigrants who applied for naturalization in Jeffer-
son County, Alabama between 1886 and 1911, 23.6 percent were natives
of Greece, Italy, and the Ottoman Empire. Greeks and Italians tended
to come from common localities, and Turks came from areas scattered
over the vast Ottoman Empire. Their mean age at the time of entry
into the United States was 21 years, and their mean age at the time
they petitioned for citizenship was 29.5 years. Residence patterns
followed occupation patterns. Those who worked in commercial or food
related occupations tended to live in Birmingham, and those who
worked as laborers or in heavy industry tended to live in Ensley and
Bessemer. Common stereotypes of the new citizens as seeming to be
short, dark, and "different" are challenged by showing that they were
of medium height and that close to half of them were fair skinned.
In addition, the work ethic was as strongly developed in the new
immigrants as it was in native born Americans and immigrants from
western and northern European nations.

Abstracts

THE LEGACY OF BOOKER T. WASHINGTON AND LOCAL POLITICS. Josetta Brittain Matthews, Department of Political Science, Tuskegee Institute, AL 36088

The political ideas expressed in Booker T. Washington's speech at the Atlanta Exposition in 1895 have served as a core around which the arrangements for the conduct of the political process in Tuskegee have become institutionalized and, in terms of a conservative-radical continuum, Tuskegee politics are significantly more conservative than the politics practiced by Black Americans elsewhere in the United States. The treatment of student demonstrations at Tuskegee Institute was rather more extreme in its harshness than the treatment of similar demonstrations at comparable institutions of higher learning, and the almost frenetic loyalty of Tuskegee Institute alumni "confirm" in the minds of the "authorities" the belief that all is well, and that extant procedures are worthy of perpetuation, notwithstanding the endorsement given to curricular modernization as a means of preserving the school's contemporary relevance and the marketability of its product. The relative affluence of the political influentials of Tuskegee, coupled with the fact of a Black numerical preponderance in the town and the county appear to have tied the Black population to the preservation of the status quo and the illusions that inhere in it, even as Tuskegee itself, its claim to be "the pride of the swift-growing south" notwithstanding, continues to be starved of resources relative to other communities, and the Black population continues to lag behind the Whites in terms of voter registration.

A LEGAL ANALYSIS OF THE UNITED STATES INTERVENTION IN GRENADA. Walter E. Stewart, Department of Political Science, Tuskegee Institute, AL 36088

The armed invasion of Grenada by the United States appears to have been executed in defiance of well-established rules of international law, notably of the Kellogg-Briand Treaty, Article 2(4) of the Charter of the United Nations Organization, rules of customary international law governing the exclusivity of the jurisdiction of the territorial sovereign, and the concomitant exclusion of the cognizance of a state's domestic or internal politics by another state and, what is of more particular relevance to the present episode, the active military intervention by a state, based upon its own appreciation of whether or not political developments in another state comported well with its own best interests. An intervention to protect American nationals cannot be justified, since the safety of those nationals was never threatened, and since the intervention itself went well beyond the removal of said nationals. Similarly, the invocation of the mutual defense articles of the treaty establishing the East Caribbean Organization is inappropriate, in that those provisions must have been aimed at combatting aggression by states external to the parties, the absurd alternative being that a government would become a party to a treaty that could be invoked as a means of effectuating its own demise, that invocation being carried out by the other parties to the very same treaty who, because of their relative powerlessness, would have the privilege of calling in the military might of the United States to do that which they were unable to do unaided.

HEALTH SCIENCES

DANGEROUS FOLK MEDICINE PRACTICES. <u>Robert E. Pieroni,</u> Dept. of Internal Medicine, Univ. of Ala., University, AL 35486.

The debt that medical science owes to many folk medicine practices is well recognized. Smallpox inoculation and the use of digitalis and other medications are examples of folk practices which became incorporated into orthodox medicine. The "back to nature" movement combined with fear or distrust of traditional medicine has lent impetus to a rejuvenation of folk medicine in its varied forms. Many folk practices are neutral in that they have no untoward effects on health; a few practices are actually beneficial. Unfortunately, little attention has been directed toward the many folk beliefs and practices that are harmful and, in some instances, deadly. The media constantly bombards consumers with purported virtues of "old-timey" products and remedies having doubtful efficacy. Such notions, lotions and potions are purveyed in a reckless manner with wild claims of "time-tested value." Sexual vigor, longevity and "cures" for cancer and other plagues of mankind are often sought in health food stores and other outlets where "miracle nutrients" can be obtained. Unfortunately, the dictum "Caveat emptor" is seldom considered and tragic consequences may ensue. For example, arsenic and cyanide poisonings have resulted from ingestion of kelp and apricot kernels. Ginseng, used for centuries for its purported life-extending and aphrodisiac qualities, has been associated with hypertension and a severe withdrawal syndrome. Vitamin B_{15} or pangamic acid, a big moneymaker for health food chains and supposedly a panacea and old-age rejuvenator, has recently been shown to be mutagenic. Herbal teas and bee pollen have been associated with toxic reactions. The list is long and tragic. We shall examine some harmful folk medicine practices and recommend means by which potentially noxious practices can be recognized and avoided.

CHRONIC HYPOKALEMIA IN A YOUNG ADULT MALE. <u>Glen D. Heggie</u> and Robert E. Pieroni, Dept. of Internal Medicine, Univ. of Ala., University, AL 35486.

Ingestion of chewing tobacco can cause hypokalemia and hypertension secondary to its licorice content. We report a case of chronic hypokalemia and hypertension spanning a period of four years in a 31 year-old male. Evaluation of his hypertension revealed persistently suppressed renin levels despite stimulation with salt restriction, furosemide, and upright posture. Concurrent aldosterone levels were also suppressed. The patient eventually admitted chewing up to 8-10 plugs of tobacco per day during this period. The pathological effects of hypokalemia in this situation are discussed.

HIGH AFFINITY CYCLIC AMP PHOSPHODIESTERASE: REGULATION IN 3T3-L1
FIBROBLASTS. <u>John E. Souness</u>, Chuen-Cheh Shen, W. Joseph Thompson and
Samuel J. Strada, Dept. of Pharmacology, Coll. of Med., University of
South Alabama, Mobile, AL 36688.

Insulin in combination with dexamethasone (DEX) and/or 3-isobutyl-
methylxanine (IBMX) induces morphological and biochemical changes in
3T3-L1 cells indicative of differentiation. In contrast to undifferen-
tiated cells, insulin increases the activity of a low Km form of cAMP
phosphodiesterase (PDE). We have utilized a sheep polyclonal mono-
specific antibody raised to a purified high affinity cAMP PDE from dog
kidney. The characteristics of changes in cAMP PDE during the differen-
tiation process <u>per se</u> and in response to hormone and drug treatment
were analyzed by comparison of enzymatic and immunoreactivity. Differ-
entiation of these cells induced by any combination of insulin, DEX and
IBMX was associated with a 3-fold increase in low Km cAMP PDE activity
in a crude microsomal fraction (P_2) consisting of plasma membrane
fragments and endoplasmic reticulum. Similar changes in cGMP activity
in the P_2 fraction or in the cAMP PDE of the cytosolic fraction were not
observed. Addition of insulin to differentiated cells elicited a 60%
further selective increase in the low Km cAMP PDE activity in the P_2
fraction. Western analysis by immunoblots showed that neither differen-
tiation <u>per se</u> nor insulin treatment increased the amount of low Km cAMP
PDE as judged by cross-reactivity with the antibody. These results
suggest that the increase in low Km cAMP PDE activity observed in the
membranes of 3T3-L1 during differentiation or in response to insulin are
due to either post-translational modifications of existing low Km
enzyme, an increase in the amount of a non-immunoreactive species of
PDE, or an alteration in a regulatory component of the enzyme.

PERCUTANEOUS ULTRASONIC NEPHROLITHOTRIPSY. <u>Charles W. Newell</u>, Michael
A. Harris and Deborah K. Martin, Department of Radiologic Technology,
University of South Alabama, Mobile, Alabama 36617.

Renal calculi continue to represent a significant health problem in
our society today. Percutaneous Ultrasonic Nephrolithotripsy is a
relatively new procedure currently being utilized in the treatment of
renal calculi. The procedure requires the combined utilization of
radiologic and urologic techniques. By inserting a nephroscope and
specially designed ultrasonic probe into the interior of the kidney,
renal calculi are disintegrated and removed through a percutaneous
tract. In many cases, conventional open renal surgery can be avoided
with this procedure, thereby eliminating lengthy periods of convales-
cence and other complications of open surgery.

Abstracts

DETECTION OF INVERSIONS BY HIGH RESOLUTION CYTOGENETICS OF HUMAN CHROMOSOMES

Abstracts

DETECTION OF INVERSIONS BY HIGH RESOLUTION CYTOGENETICS OF HUMAN CHROMOSOMES

Teresa L. Wang-Feng, Sara C. Finley, Wayne H. Finley and C.P. Dagg.
Department of Biology and Laboratory of Medical Genetics, Univ. of
Alabama in Birmingham, Birmingham, AL   35294

Recent improvement in chromosome analysis has resulted from use of
banding methods for staining mitotic prometaphase and prophase chromo-
somes obtained from partially synchronized cell cultures. These high
resolution banding methods have proved especially useful for the
delineation of subtle chromosome aberrations which were previously
undetectable by usual banding techniques. Twenty couples with
recurrent spontaneous abortions with or without fetal deaths, malforma-
tions, or healthy infants were evaluated cytogenetically with high
resolution banding methods to determine if small aberrations were pres-
ent. One mother had a pericentric inversion [46, XX, inv(11) (p11.12;
q12.3)] that was detected with high resolution chromosomes but not
seen in banded metaphase chromosomes. This inversion occurred in two
successive generations and transmission was from mother to daughter.
It is not certain that this finding has clinical significance. Another
mother had a paracentric inversion [46, XX, inv(13) (q13.2;q22.1)]
which was identified in banded metaphase chromosomes but required high
resolution studies to clarify the break points. One child of this
mother had normal chromosomes and another was an inversion carrier.
Cytogenetics may provide evidence for causes of miscarriage. A
chromosome inversion can produce a gamete by uneven crossing-over that
has duplication/deficiency of chromosome material. This may explain
fetal wastage in some families.

SYMPTOMATIC GRANULOMATOUS MYOSITIS. Robert E. Pieroni, Dept. of
Internal Medicine, Univ. of Ala., University, AL 35486.

    In patients with sarcoidosis muscles frequently contain non-
caseating granulomas. Symptomatic sarcoid myopathy, especially
as a presenting and apparently sole manifestation of the disease,
is, however, a rare occurrence. For the past several years I have
treated a middle-aged male who presented with severe weakness of
his proximal muscles. His muscle enzymes were markedly elevated,
and biopsy revealed granulomatous myositis. There was no evidence
of involvement of other organs. Treatment with high dose prednisone
was initiated, and the patient was maintained on alternate day
steroids with rewarding results. Current knowledge concerning this
intriguing disorder, it's therapy, and it's natural history will
be reviewed.

RECIPROCITY IN EARLY MOTHER-INFANT PLAY: NURSING DIAGNOSES. Ellen B. Buckner, University of Alabama School of Nursing, University of Alabama in Birmingham, Birmingham, Alabama   35294.

The development of maternal-infant reciprocity is considered a task of early parenting, and prescriptions to facilitate that process can be an appropriate nursing intervention. This study was done to determine the usefulness of the Mother Infant Play Interaction Scale* for practice with the specific focus on its ability to delineate nursing diagnoses. Twenty mother child pairs were observed by the nurse investigator during a well-child visit when the infant was less than eight weeks post-term. Mothers were asked to play with their infants and behaviors were scored. The reliability coefficient for the scale was above 0.9, giving it a reliability sufficient to discriminate individual differences. Maternal and infant subscale scores could then be used to determine etiologies.

Nursing diagnoses were delineated as follows: positive or facilitating diagnosis when problems are not present and three problem-etiology diagnoses in which the problem was "alteration in maternal-infant reciprocity" and etiologies were "related to maternal factor", "infant factor" or "combined factor". Defining characteristics for each diagnosis were based on normative data from the study with criterion levels established at one standard deviation below the mean. This tool can be used in practice as a basis for the diagnosis and treatment of the human response occurring between mother and infant in their early dyadic development.

*Walker, L. O. and Thompson, E. T. (1982). Mother-Infant Play Interaction Scale. In S. S. Humenick (Ed.) Analysis of current assessment strategies in the health care of young children and childbearing families. Norwalk, CT: Appleton-Century-Crofts.

IDENTIFICATION OF AN ENCAPSULATED STRAIN OF STREPTOCOCCUS FAECALIS. Holly K. Hall and William B. Davis, University of South Alabama, Mobile, Alabama 36688.

A unique mucoid strain of Streptococcus faecalis was identified in a renal specimen obtained from a patient with significant urinary tract infection. The organism produces a gray, opaque, non-hemolytic colony on sheep blood agar which can be clearly distinguished from wildtype S. faecalis by a distinct mucoid appearance. The isolate was serologically identified as a member of the Group D streptococci and confirmation of species was accomplished by conventional as well as rapid biochemical methods. Microscopically, the presence of a capsule was suggested by a clear zone surrounding each organism in India Ink preparations. Transmission electronmicroscopy also revealed the presence of a copious amorphous substance encasing organisms in colonies fixed with gluteraldehyde and formaldehyde.

SOCIAL DEVELOPMENT OF PRESCHOOL CHILDREN IN HOME CARE AND DAY CARE
SETTINGS. Patsy H. Schmith, Chauncey Sparks Center for Developmental
and Learning Disorders and Nancy R. Currier, University of Alabama,
School of Nursing, University of Alabama in Birmingham, Birmingham,
Alabama 35294.

With the increasing rates of maternal employment and single par-
enthood, use of child care services has steadily grown in the United
States. Studies such as that of Auerbach (1981) have found that the
number of working mothers has increased by 79% since 1970. Controversy
continues to exist among many professionals regarding the types of
child care alternatives and the influence of environment upon the
behavior and development of children. Therefore, many parents have
difficulty selecting child care services. In this study a comparison
of social maturity of three- and four-year-old children in day care
and home care settings was made by interviewing mothers of the subjects
using the Vineland Social Maturity Scale. A nonrandomized sample con-
sisting of 51 white, middle-class three- and four-year-olds partici-
pated in the study. Twenty-five children were enrolled in a licensed
day care setting and 26 were in a home care setting. Demographic data
were complied and categorized according to birth order, number of
siblings, mother's age, mother's level of education, sex of the child,
and environmental placement. Descriptive statistics were used in ana-
lyzing the data. A one-way analysis of variance (ANOVA) was performed
to test the significance of differences between means of the two
groups. One-way ANOVA was also conducted for each of the variables
described. No statistically significant differences were found. Re-
sults of this study demonstrated similar social maturity levels of
preschoolers in day care settings and in home care settings.

ENDOCARDITIS IN THE ELDERLY: A DIAGNOSTIC DILEMMA. Rebecca S.
Rainer and Robert E. Pieroni, Dept. of Internal Medicine, Univ. of
Ala., University, AL 35486.

Although the incidence of acute rheumatic fever has declined
appreciably, endocarditis still results in considerable morbidity
and mortality, especially among the elderly. With the increasing
longevity of our population chronic atherosclerotic damage to heart
valves can more readily be manifested by endocarditis. Signs and
symptoms of this infection are often attenuated or atypical in the
elderly - with resultant delay in therapy. This delay is especially
likely to occur in the small minority of subjects whose blood cul-
tures fail to grow any organisms. We shall present several cases
of endocarditis in elderly patients including a culture-negative
variant. Emphasis will be placed on describing some of the diag-
nostic clues which should alert the clinician to the possibility
of valvular infection in elderly patients.

Abstracts

COMPUTERS IN PHARMACOKINETICS: EXREG, A POLYEXPONENTIAL CURVE-
STRIPPING PROGRAM. James D. Henderson, Dept. of Medicine, William S.
Aultman, Jr., and Marino J. Niccolai, Dept. of Computer Science,
University of South Alabama, Mobile, AL 36688. William R. Ravis,
Dept. of Pharmacal Sciences, School of Pharmacy, Auburn Univ., AL
36849.

EXREG is a BASIC microcomputer program for polyexponential curve-
stripping which represents plasma concentration-time data as the sum
of a maximum of three exponentials $C(t)=P(1) * EXP (-P(2)*T) + P(3) *
EXP (-P(4) * T) + P(5) * EXP (-P(6) * T)$. The program uses the
classical residual, peeling-off technique with a minimum of three data
points for the terminal phase and two data points for initial and
intermediate phases. Three types of linear kinetic models after
single doses are treated: intravenous bolus or infusion (1-3 com-
partments, where infusion is zero-order and elimination occurs only
from a central compartment), and extravascular (1-2 compartments,
where absorption is first order). After data entry, EXREG will
automatically determine the best fit to the desired number of expo-
nentials based on the unweighted sum of squared deviations from which
Akaike's Information Criterion is determined (lowest value gives the
correct model). Residual values and model parameters are calculated
and data files may be stored, retrieved, and edited. Versions of
EXREG exist for the IBM Personal Computer and the IBM Instruments
CS9000. Comparison with CSTRIP (Fortran IV mainframe program) of the
results of analysis of three data sets (9-18 points) gave an average
coefficient of variation of 1.2% for 18 parameters. Current work is
focused on combining the curve-stripping routine with a nonlinear
regression algorithm for optimal curve fitting.

HYPERTHYROIDISM AND MITRAL VALVE PROLAPSE. Fred McMurray and
Robert E. Pieroni, Dept. of Internal Medicine, Univ. of Ala.,
University, AL 35486.

An increase in adrenergic tone occurs in both hyperthyroid
patients and in those with mitral valve prolapse (MVP). Patients
may manifest many similar symptoms in both of these disorders. We
are currently treating several patients who have been diagnosed as
having both thyrotoxicosis and MVP. Other workers have described
an apparent higher incidence of MVP in hyperthyroid patients. On
the other hand, it has been claimed that this association is more
apparent than real in that patients with evidence of autonomic
hyper-reactivity are often screened for both disorders. We shall
present cases of patients having both hyperthyroidism and MVP, and
review data pertinent to the association of these disorders. The
important role of proper diagnosis in order to avoid unnecessary
treatment of such patients will be emphasized.

COMPETENCE PATTERNS OF YOUNG RETARDED CHILDREN. Carol J. Dashiff, Sharon Leder, and Deborah McNeil, School of Nursing, Univ. of Ala. in Birmingham, University Station, Birmingham, AL 35294.

This study describes the competence patterns of one- to two-year old retarded children and examines whether the mothers' behavior differs according to the identified patterns. Wenar's definition of executive competence was the foundation for the study. The subjects were 18 mother-child pairs who were participants in an infant program at the Chauncey Sparks Center for Developmental and Learning Disorders. The volunteer sample participated in three data collection sessions, including the videotaping of an unstructured play situation. Videotapes were analyzed for child competence using the Hendrickson-Hansen Instrument for Observing Categories. Interrater reliability was maintained at 85% agreement. Two groupings of children were identified based on a Q-factor analysis. Type I (n=13) was characterized by a greater frequency and longer duration of gross motor behavior ($\alpha = .05$). Type II (n=5) was characterized by a greater frequency and longer duration of visual behavior ($\alpha = .05$). Both characerizations occurred in session one. Interactional matrices further supported and elaborated the two types. Mothers' behaviors were significantly different when examined by the Mann-Whitney U test. Mothers of Type I children, when compared to mothers of Type II children, changed their behavior less frequently, interrupted less frequently, and engaged more often in behavior coded as "other". The findings indicate that young retarded children have varying competence patterns. These patterns are different than the patterns of normal children which have been described in the literature and have implications for assessment. (Supported by USPHS Grant No. NU00835).

CALMODULIN-DEPENDENT PROTEASE OF HUMAN NEUTROPHILS. Janet L. Legendre and Harold P. Jones, Department of Biochemistry, Univ. of South Ala., Mobile, AL 36688.

A calcium-sensitive neutral protease has been identified in human neutrophils. The enzyme has been partially purified from the cytosolic fraction and characterized. The protease has a pH optimum of 7.5 and is half-maximally active at free calcium concentrations of 7 M. The molecular weight of the protein is approximately 93,000 daltons, as determined by gel filtration using Sephacryl SF-300. Enzyme activity is eluted from DEAE-Biogel at an ionic strength of 0.25 M NaCl. Numerous fluorogenic peptides were investigated as potential substrates for the enzyme, but none were cleaved. The role of the protease in the regulation of neutrophil functioning is currently under investigation. (Work supported by a grant from the Council for Tobacco Research – USA, Inc.)

DIETARY FATS IN DIETS OF TEENAGE GIRLS. Mieke van den Reek, Margaret Craig-Schmidt and A. J. Clark, Dept. of Nutrition and Foods, John D. Weete, Dept. of Botany, Plant Pathology and Microbiology, Auburn University, AL 36849.

The determination of fat consumption patterns of various groups is important because of possible adverse effects of dietary fat on the health of the American population. In the present study, diet records and weighed duplicate portions of foods for one week were obtained from eight healthy adolescent girls. Caloric consumption, total fat intake, linoleic acid (18:2) content and the ratio of polyunsaturated to saturated fatty acids (P/S ratio) were calculated from the dietary records using nutrient composition tables. Average daily energy intakes ranged from 1086 to 1735 kilocalories (kcal), with 33 to 40% of the total kcal as fat. The diets had an 18:2 content ranging from 3.6 to 8.2% of the total kcal and a P/S ratio of 0.32-0.65. Diets, obtained by the duplicate portion method, were homogenized and analyzed for fatty acids by gas liquid chromatography. Trans-isomers of 18:1, the predominant form of isomeric-fatty acids in the diet, comprised on the average 3.6 to 8.5% of the total fatty acids. The average fat intake was typical of the American diet but higher than the 30% of kcal advised by the U. S. Dietary Goals. The 18:2 content of the diets was high enough to prevent essential fatty acid deficiency, but both the 18:2 content and the P/S ratio were somewhat lower than the recommended values. The amount of isomeric-fatty acids in these diets agrees with previously estimated values. Knowledge of the trans-fatty acid content in the human diet is useful in evaluating studies on the biological effects of these isomers. (Supported in part by Projects AL 521 (S-150) and AL 494 from the Alabama Agricultural Experiment Station.)

PNEUMOCOCCAL PNEUMONIA: THE CASE FOR AN OUNCE OF PREVENTION. Robert E. Pieroni and Thomas J. Burchett, Dept. of Internal Medicine, Univ. of Ala., University, AL 35486.

In the U.S. pneumonia is the fifth leading cause of death - accounting for over 50,000 deaths yearly, seven million days of hospitalization and over three times as many disability days. Studies indicate that about half a million Americans will develop pneumococcal pneumonia this year. Of the 25 percent of patients who become bacteremic, 28 percent will die. The mortality rate is especially high among aged or debilitated patients - ranging from 25-50 percent. In recent years a vaccine that protects against most strains of pneumococci has been introduced. Unfortunately, only a small minority of those for whom vaccination is recommended have received vaccine. We shall present a case report of pneumococcal pneumonia in an elderly female in order to underscore the cost effectiveness of vaccination. Issues concerning vaccine safety, efficacy, as well as current recommendations for vaccinations will be outlined.

Pharmacological Pretreatment of Cerebral Ischemic Damage. Michael D. Taylor and James L. Parmentier, Department of Anesthesiology, University of South Alabama, Mobile, Alabama, 36688

Ischemic damage to the CNS occurs both during periods of reduced blood flow and following its reestablishment. Secondary, or reflow, damage is due in part to an altered oxygen metabolism following ischemia which leads to the generation of highly reactive free radicals. Methylprednisolone (MP), a steroidal anti-inflammatory drug, is effective in ameliorating cerebral ischemic damage in clinical practice. MP was found to protect against secondary ischemic damage in an animal model of global cerebral ischemia and reflow (Taylor et al, (1982) Exp. Neurol. 76:495-507). We have extended these studies using the In Vitro hippocampal brain slice preparation which allows for well controlled delivery of gas mixtures to exposed neurons on its upper surface. Hypoxia was induced by replacing the control gas (95% O_2, 5% CO_2) with an anoxic gas mixture (95% N_2, 5% CO_2) for varying lengths of time. Functional synaptic excitability was assessed by stimulating Schaeffer collaterals while extracellularly recording excitatory postsynaptic potentials (EPSPs) and population spikes in the CA1 pyramidal layer. Hypoxia lasting for more than two minutes results in total loss of synaptic transmission in the untreated brain slice. Reoxygenation after 3 to 10 minutes of hypoxia will allow partial recovery of potential amplitudes. Following ten minutes of hypoxia, almost no recovery was possible. However, pretreatment with 10 uM MP allowed complete recovery of the population spike amplitude after 10 minutes of anoxia provided the drug was available to the tissue at least as soon as synaptic failure begun to occur. The results indicate that MP acts to stablize cell membranes from the deleterious effects of reoxygenation.

NEUROLEPTIC MALIGNANT SYNDROME: CASE REPORT. David N. Bolus and Robert E. Pieroni, Dept. of Internal Medicine, Univ. of Ala., University, AL 35486.

Although the neuroleptic malignant syndrome (NMS) was described nearly twenty years ago, this life-threatening syndrome is often unrecognized by clinicians. NMS is characterized by hyperthermia, extrapyramidal dysfunction, as well as disturbances of the autonomic nervous systems in patients using neuroleptic medications. This idiosyncratic reaction to major tranquilizers has been associated with a mortality rate of about 20%. Recently, a young male who had been receiving psychotropic medications presented to our emergency room in a delirious state with fever, marked rigidity, and other manifestations of the NMS. Meningitis was originally suspected but was ruled out by appropriate studies. This patient's clinical management, including the use of bromocriptine, will be discussed, as will the need for prompt recognition of this uncommon, but potentially lethal, syndrome.

Malnutrition and Oral Health in Rural Peruvian Schoolchildren.
<u>Miryam S. Miyamoto</u> and George T. Laven, Dept. of Nutrition Science,
Univ. of Alabama in Birmingham, Birmingham, AL 35294.

Protein malnutrition during tooth development increases suscep-
tibility of teeth to dental caries in experimental animals.   The
present study was carried out to evaluate the association between
nutritional status and oral health in school children.   438 rural
schoolchildren (5-18 years old) from Tambo, Peru were examined.   Nutri-
tional status was estimated by height, weight-for-height, arm muscle
circumference and skinfold.   Oral health was assessed by number of de-
cayed permanent or deciduous teeth, index of oral hygiene, and pres-
ence of gingivitis or enamel defects.   Parotid saliva from a subgroup
of 57 children was collected to determine IgA and protein concentra-
tion.   Compared with North American children the subjects had lower
height (89.05 + 4.44% of median for age), and higher weight-for-
height (108.07 + 12.44% of median).   Caries, enamel defects and gin-
givitis were present in 84%, 9% and 30% of the children, respectively.
No significant associations between nutritional status and caries,
salivary IgA, salivary protein, or gingivitis were found.   Children
with enamel defects had significantly poorer oral hygiene (p < .01),
and lower weight-for-height and arm muscle circumference (p < .05)
than those without defects.
       The results lend support to a role for malnutrition in the eti-
ology of enamel defects.   However, the lack of association between
nutritional status and caries does not rule out the possibility that
malnutrition increases caries susceptibility, since the cariogenic
challenge, i.e. frequency of eating, is likely to be greater for well-
nourished than malnourished children.

DIFFERENCE BETWEEN LEVELS OF PERCEIVED PAIN OF A PATIENT WHO
EXPERIENCES CHRONIC PAIN PRIOR TO AND SUBSEQUENT TO NURSING
INTERVENTION.   Patricia B. Espy, School of Nursing, Univ. of Ala. in
Birmingham, Birmingham, AL 35294.

Previous studies have generated data to suggest a positive rela-
tionship between nursing interventions and relief of pain in patients
with physiologically induced pain.   In the present study the nursing
interventions of asking the patient to rate pain perception on an
ordinal scale and teaching the proper use of analgesics as prescribed
by a physician to relieve chronic pain were the independent variables.
The design was a single subject case study utilizing an A-BC-B
application of the independent variables with a subject who has a
malignant solid tumor mass with metastases.   Data of the study suggest
that the nursing interventions of asking the patient to rate pain
perception on an ordinal scale and teaching the proper use of
analgesics as prescribed by a physician to relieve chronic pain may
result in a lowered level of perceived pain in patients with
physiologically induced pain.

IMMUNOLOGICAL STUDIES OF RAT LIVER MEMBRANE CYCLIC AMP PHOSPHO-
DIESTERASES. C-C. Shen, P. Blackshear, S.J. Strada*, and W.J. Thompson*
Dept. of Pharm. Univ. of South Alabama, Coll. of Medicine, Mobile, AL
and Diabetes Unit, Harvard Med. Sch., Boston, MA

Monospecific Type IV cA phosphodiesterase (cA PDE) antibody raised
in sheep against puried dog kidney enzyme was used to identify immuno-
reactive cA PDE in rat liver. The antibody does not react with Types
I, II and III PDE. Analysis by Western immunoblots with 10% SDS-gel
electrophoresis shows one immunoreactive cA PDE in liver homogenate
of Mr 60,000. Crude microsomal membrane fractions contain not only
the same Mr 60,000 immunoreactive protein but also an additional Mr
63,000 reactivity. Tris buffer, NaCl solution, and freezing and thawing
only release the 60,000 cA PDE, while Triton X-100, sodium carbonate
and sonication release both immunoreactivities from the membranes. The
ratios of immunoreactivity and cAMP or cGMP hydrolysis suggests that
the 63,000 dalton species is enzymatically inactive. Partial purifica-
tion of the Triton X-100 extract by DEAE-cellulose and GHA chromato-
graphies show that the Mr 63- and 60,000 proteins comigrate. Gel
filtration shows the proteins to be polymeric with apparent native Mr's
of 240,000, 120,000 and 60,000. The NaCl solubilized immunoreactive
cA PDE showed only Mr 120,000 and 60,000 species with the 120,000 being
active enzyme. Similar anomalous kinetic behavior of the membrane
extracts were observed which were indicative of Type IV cA PDE activity.
Liver membranes contain 60,000 dalton Type IV cA PDE. The immuno-
reactive 63,000 dalton protein present in liver membranes has not been
found in other tissues and may play a regulatory role in liver low Km
cA PDE (Type IV) activity modification by hormones and drugs. Supported
by USPHS grant GM 33538.

APPLICATIONS OF MICROCOMPUTERS IN BEHAVIORAL SCIENCES.
James L. Fitch, Dept. of Speech Pathology & Audiology,
Univ. of So. Ala., Mobile, AL 36688.

The study of human behavior has traditionally been
accomplished through the use of subjective data, i. e.,
psychological tests, observations and situation
responses. Theories of behavior formulated on this type
of data have resulted in treatment techniques that are
subjective in form and content and mediated by human-human
interaction. Currently there are developments which are
reversing this tradition. Human-computer interfaces now
have the capability of quantifying speech input, video
forms can be computer processed and a host of physiologi-
cal transducers exist which measure human response and can
digitally encode information to the computer for process-
ing. The result of these developments will be a more
scientific basis for the study and treatment of human
behavior.

Abstracts

PIAGET'S THEORY AS A FRAMEWORK FOR A NURSING INTERVENTION WITH FAMILY MEMBERS OF CRITICALLY ILL PATIENTS. Dianne Piazza, University of Alabama School of Nursing, UAB, Birmingham, AL 35294.

The purpose of the study was to describe a nursing intervention and the cognitive functioning and comfort of family members of critically ill patients. Based upon Piaget's Theory, a classification hierarchy of all elements within an intensive care unit (ICU) environment was used as a framework for the nursing intervention, instrument development and data scoring. Subjects were interviewed initially to determine what they expected to observe (cognitive functioning data) and how they expected to feel (comfort data) regarding the patient and the environment. The subjects received the nursing intervention which consisted of interacting with the investigator, manipulating objects in a replica patient care station, viewing photographs of a patient and ICU environment, and listening to recorded sounds of equipment. Comfort data were collected again before subjects visited the patient. Subjects were interviewed once more to determine what they observed and how they felt about the patient and environment. There were statistically significant differences between the mean baseline and mean post-visitation cognitive functioning data and comfort data. There was a statistically significant difference between the mean baseline and mean post-nursing intervention comfort scores. Subjects knew more about the ICU after the nursing intervention and visit to the ICU than before. Subjects were more comfortable after the nursing intervention than before. The hierarchy provided the framework for the study and guided the entire research endeavor. A seed grant from Sigma Theta Tau, Nu Chapter, supplied partial funding for the research.

WILSON'S DISEASE: AN UNUSUAL PRESENTATION. John Murray, Glen Heggie, and Robert E. Pieroni, Dept. of Internal Medicine, Univ. of Ala., University, AL 35486.

Wilson's disease is rarely considered in adults presenting in acute or chronic hepatic failure. Because of this, many cases of Wilson's disease may go undiagnosed and untreated with almost uniformly fatal results. There is a significant subset of patients with Wilson's disease who present with a picture of active hepatitis or fulminant hepatic failure, and in whom serum ceruloplasmin, the commonly employed screening test, is normal or even elevated. Likewise, serum copper levels may also be normal and Kayser-Fleischer rings may not be evident even under slit-lamp examination. Recently we treated a thirty-nine year old white female who presented with fulminant hepatic failure. She had normal serum ceruloplasmin levels and absent Kayser-Fleischer rings. Additionally, she displayed no abnormal neurological signs. Her case will be discussed in detail. A review of the necessary diagnostic criteria needed to correctly and timely diagnose Wilson's disease will be discussed as well as various therapeutic modalities.

MULTIPLE CAUDAL NEURAL TUBES PRODUCED IN ICR MOUSE EMBRYOS BY RETINOIC ACID

Anne M. Cusic and C.P. Dagg. Department of Biology, University of Alabama in Birmingham, Birmingham, AL 35294.

 Pregnant ICR mice were dosed orally with all-trans retinoic acid (RA) on day 9 of gestation. When the fetuses were examined on day 18, they displayed a variety of gross defects including shortened tails and missing tails. The incidence and severity of tail defects were dependent upon the dosage of RA, which was given at 25, 50, 100, and 200 mg/kg. No defects were produced at 25 mg/kg. Short tails were found in 19% of the fetuses dosed with 50 mg/kg, and at 200 mg/kg all fetuses has shortened or missing tails. Embryonal development of the tail defects was followed by examining the embryos 24, 48, and 72 hours after the administration of RA at 200 mg/kg. Histological sections showed anomalous bud-like outgrowths from the ventro-lateral surface of the sacral and caudal neural tube on day 10. By day 11 some of these outgrowths were disorganized while others resembled small normal neural tubes. Hemorrhagic foci were found at the tail tip and along the ventral side. By day 12 many embryos had no tails. In the day 12 embryos with tails, histological sections showed multiple neural tubes, as many as 8 in the tail of one embryo. The development of the RA-induced defects was compared with neural defects caused by other teratogens and mutant genes. The morphogenesis of multiple neural tubes caused by RA was similar to that of embryos carrying the mutant gene, Fused, but was unlike those in published descriptions for other mutant genes and teratogens.

Mini-Tube Bile Esculin Deep and Pyroglutamyl-β-Naphthylamide for the Rapid Differentiation of Group D Streptococci. HOLLY K. HALL*, Univ. of South Alabama, Mobile, AL 36688.

    To aid in the therapeutic management of streptococcal infections, an improved rapid identification system which differentiates enterococci from other group D streptococci has been devised. A modified mini-tube bile esculin agar deep (BED) technique and pyroglutamyl-β-naphthylamide (PYR) was employed using 130 clinical isolates of alpha and nonhemolytic streptococci. Among 116 isolates which were confirmed at 24 hours by conventional tests as group D streptococci, 114 were positive at 2 hours by the mini-BED technique. Of 106 isolates confirmed as enterococci, 105 were PYR positive at 2 hours. Predictive value positive indices were 98% and 100% for the mini-BED technique and PYR test respectively, while the predictive value negative indices were 86% and 96% respectively. These data suggest that the mini-BED technique provides a reliable criterion for the identification of group D streptococci at 2 hours. Proceeding to read the PYR test at that time is highly sensitive and specific for identification of enterococci. When combined, these 2 tests result in a superior system that is economical and simple to perform.

Abstracts

CLIENT DECISION MAKING: A MODEL FOR ONCOLOGY
NURSING PRACTICE

James C. Pace, School of Nursing, University of Alabama
in Birmingham, Birmingham, Alabama   35294

Oncology Nurses are increasingly being asked by their clients for
help in making decisions regarding treatment. A model was developed
for use by the nurse in such situations that incorporates Orem's
(1980) self-care theory of nursing, Anthony & Carkhuff's (1976) help-
ing behaviors, and the bioethical perspective of situationalism.   A
case study approach utilizing six outcome criteria to measure problem
resolution was implemented to ascertain the effectiveness of the
model. The client selected for study asked the nurse for help
in deciding if he should take investigational chemotherapy after he
proved refractory to conventional treatment of Stage IVB Hodgkin's
Disease. Following implementation of the model, the client decided
to refuse treatment and to return home where he wanted to die.
Findings support the use of the helping behaviors described by
Anthony & Carkhuff (1976) which facilitate client decision-making
and goal setting. All six outcome criteria were met. It is believed
that the use of such a model offers the nurse a means to effectively
help clients in their decision making processes.

Orem, D. Nursing: Concepts of Practice, ed. 2. New York:
McGraw Hill Book Company, 1980.
    Anthony, WA & Carkhuff, RR: The Art of Health Care: A Handbook
of Psychological First Aid Skills. Amherst Massachusetts: Human
Resource Development Press, 1976.

EFFECT OF VIRUS SPECIFIC ANTIBODY ON HERPES SIMPLEX VIRUS TYPE 1
(HSV-1) REPLICATION IN MOUSE CORNEAS. Stephen Day, John E.
Oakes, and Robert N. Lausch, Dept. of Microbiology and
Immunology, College of Medicine, Univ. of South Alabama, Mobile,
AL   36688.

    Previous studies in our laboratory have shown that passive
transfer of antibody will enable mice to recover from ocular HSV-
1 infection. Current efforts are directed toward identifying how
antibody protects in vivo. To that end, rabbit hyperimmune serum
prepared against HSV-1 and a monoclonal antibody pool specific
for the 4 major glycoproteins of the virus (gB, gC, gD, and gE)
were tested for their capacity to inhibit HSV-1 replication in
murine corneal cultures. It was found that both the polyclonal
and monoclonal antibody preparations significantly inhibited
production of infectious progeny. This suppression was achieved
in the absence of exogenously added complement or
immunologically reactive cells. Thus, immunocytolysis could not
account for the suppression. The hypothesis that antibody
binding to viral glycoproteins present on the surface of infected
corneal cells suppresses virus synthesis is being investigated.

Abstracts

MEDICARE PROSPECTIVE PAYMENT SYSTEM AND IMPLICATIONS
FOR NURSING. Elizabeth J. Kittrell, College of Nursing,
University of South Alabama, Mobile, Al. 36688.

ln March of 1983, Congress approved a new system of reim-
bursement for in-hospital Medicare patient care. This
prospective payment system (also called "D.R.G.'s" - for
Diagnosis Related Groups) is to be gradually implemented
over the next three years, with serious implications for
the health care industry, and especially for the nursing
profession. Basically, the patient's principle diagnosis,
sex, age, surgical procedure, and the presence of complica-
tions(s) are used to determine the D.R.G. to which the
patient is assigned. The hospital is reimbursed an amount
of money which is pre-determined for this category, regard-
less of the cost, or savings to the hospital. The possibi-
lities for nursing position cutbacks are quite threatening
to the security of nursing personnel nationwide. Nursing
departments will also be pressed to justify operational
costs such as staffing, and innovative programs such as
career ladders. Patient education will take on a more
important role than ever, in an effort to decrease patient
length of stay. Nurses at all levels will be encouraged to
identify and implement cost-saving measures such as decreas-
int the nosocomial infection rate, and more carefully coor-
dinating the patient's ancillary needs. The nursing
profession will find itself on new proving ground as
hospitals, where 65% of the nation's nurses are employed,
learn to cope with these expansive changes.

ISOLATION OF ETHIDIUM MONOAZIDE PHOTOPRODUCTS. Suzanne Byrd and
L.W. Yielding, Department of Biochemistry, College of Medicine,
University of South Alabama, Mobile, AL 36688.

The compound, ethidium bromide, demonstrates a broad spectrum of
biological actions. Although ethidium has been the focus of con-
siderable study, the underlying molecular mechanisms responsible for
its activity are still unknown. Photoaffinity probes are currently
being used to elucidate the mechanisms of drug action by identifying
the in vivo target. Ethidium monoazide (3-amino-8-azido-5-ethyl-
6-phenyl-phenanthridinium chloride) has been developed as a model
photoaffinity probe for ethidium bromide. Irradiation of the photo-
affinity probe is required to produce a highly reactive intermediate
which will react with the nearest available molecule in the active
site to form a covalent adduct. If the drug is free in solution, it
will react with solvent molecules upon irradiation to form photo-
inactivated compounds or "photoproducts". Examination of these
"photoproducts" may provide information about the behavior of the
reactive intermediates. The purpose of this work has been to isolate
the "photoproducts" of ethidium monoazide using thin layer chromato-
graphy and to examine the effects of concentration, ionic strength,
pH, and time of irradiation on their formation and relative yields.

Abstracts

COMPARISON OF GENERAL AND REGIONAL ANESTHESIA ON ALTERATIONS IN NORMAL
LYMPHOCYTE RESPONSIVENESS. <u>Paul Brock</u>, Elizabeth Fowler, Aparna
Mankad, Elizabeth Petty and John N. Miller, Departments of
Anesthesiology and Microbiology and Immunology, University of South
Alabama College of Medicine, Mobile, Alabama, 36688

The objective of this research is to determine whether general
anesthetics alter the ability of the immune system to respond to
antigenic challenge. General and regional anesthetics have been
compared for their ability to alter several aspects of the immune
response in patients undergoing post-partum bilateral tubal ligations.
Samples of blood taken preoperatively, intraoperatively, 1 hour
postoperatively and 24 hours postoperatively were analyzed for leukocyte
and differential count and the effect of these serum samples on the
ability of normal lumphocytes to respond to mitogens was measured in a
lymphocyte transformation assay. Intraoperative serum samples from
patients receiving either type of anesthesia decreased responsiveness
to T cell mitogens. In contrast, intra- and post-operative sera
suppressed the response to a B cell mitogen less than the
pre-operative samples. Total leucocyte count decreased in patients
receiving general anesthesia and remained depressed for at least 24
hours post anesthesia while total leucocyte count in patients
receiving spinal anesthesia showed no significant change. Total
lymphocyte counts increased during general anesthesia and remained
elevated for 24 hrs postoperatively. The results suggest that general
anesthesia results in wider perturbations in the cellular components
of the immune system than does regional anesthesia. In addition serum
from patients receiving either type of anesthesia appears to contain
factors which suppress T cell responses.

EFFECT OF IMMUNE LYMPHOCYTES ON HERPES SIMPLEX VIRUS TYPE 1 (HSV-1)
SYNTHESIS IN MURINE TRIGEMINAL GANGLIA. <u>Carlos Monteiro</u> and
Robert N. Lausch, Dept. of Microbiology and Immunology, College
of Medicine, Univ. of South Alabama, Mobile, AL 36688.

Previous studies in our laboratory have shown that addition
of non-neutralizing monoclonal antibody to infected trigeminal
ganglion cultures could inhibit HSV-1 synthesis. We investigated
whether lymph node cells from virus immunized donors could also
exert a suppressive effect. Balb/c mice were infected on the
scarified cornea with HSV-1 strain 17. Two days later infected
trigeminal ganglia were excised and placed in culture. The
neural tissue was incubated for 3 days in the presence of 10^6
normal or immune lymph node cells, then assayed for intracellular
virus content. In 3 independent experiments, virus synthesis was
reduced by 73-99% in comparison with the controls. Preliminary
studies have indicated that an HSV-1 sensitized T lymphocyte line
cultured in vitro for 6 weeks prior to testing could also
significantly inhibit virus growth. This latter observation
suggests that the virus inhibition mediated by immune T cells may
involve a mechanism independent of antibody.

Abstracts

DEVELOPMENT OF A COMPUTER MEASUREMENT SYSTEM FOR THE ESTIMA-
TION OF BIOPHYSICAL PARAMETERS OF NEUROMUSCULAR
TRANSMISSION. R. P. Dawkins, H. E. Longenecker, Jr., and S.
C. Newman, Departments of Pharmacology and Computer Science,
University of South Alabama, Mobile, Alabama 36688.

A computer software system was developed for the on-
line acquisition of electrophysiological data from an intra-
cellular neuromuscular preparation. The project adhered to
the concept of structured programming and software
engineering with a team approach. The project required over
1500 man-hours of work and produced approximately 2500 lines
of FORTRAN code with 2500 comment lines. The system was
divided into 52 separate modules plus an input/output
library of 13 modules, in the format of FORTRAN subroutines.
Data hiding was accomplished with seven labeled COMMON
blocks, each one only accessible to those modules which
required it. The structured design was maintained in the
source code file by an indented format showing hierarchy
with generous use of comment lines. Thus executed, the
software was easy to maintain when user specifications were
altered.
The software performed as designed. Signal integrity
was assured by testing for a known calibration pulse before
acceptance. The software then automatically measured the
stimulus evoked end plate potential, stored the values, and
averaged the signal. The end plate potential amplitude
values were used for fitting the appropriate binomial model
and thereby estimating the statistical parameters.

SOCIALIZATION OF BACCALAUREATE NURSING STUDENTS. Wendy DiMicco,
Billie Rozell, Linda Reed, and Nancy Keller, University of Alabama
School of Nursing, Univ. of Ala. in Birmingham, B'ham, Al 35294.

The purpose of this study was to ascertain if differences exist
in the socialization of traditional and nontraditional nursing students
in the baccalaureate nursing curriculum. Nontraditional students were
defined as having at least one of the following criteria: a previous
degree, established career prior to entering nursing, age greater than
25, sex = male, married, responsible for child care, and enrolled in
the Educational Mobility Plan which includes previous RN's, LPN's,
corpmen, or others having taken health related coursework.
The data collection tool was the, "Nurses' Professional Orien-
ion Scale." It was designed to measure congruence between student
perceptions and faculty views of the professional nursing role. It
has been completed by all faculty and entry level students, and
students will complete it again at the end of each level until gradua-
tion. Data collection began spring 1983 and will end fall 1985. Data
indicates that faculty are homogeneous in their views of nursing. Data
will be analyzed to detect differences in socialization between
traditional and nontraditional students and to determine patterns of
socialization throughout the curriculum with emphasis on the final
preceptorship experience.

210

FACTORS AFFECTING EMPLOYMENT OF REGISTERED NURSES IN THE STATE OF
ALABAMA. JoAnn Broadus, Sharon Chumney, Vera Douglas, Carol
Henderson, and Jean Sims, College of Nursing, University of South
Alabama, Mobile, AL 36688.

The purpose of this study was to replicate the Wandelt Study and
to determine reasons why nurses are working or not working in the
state of Alabama. The Wandelt Study focused on the conditions of
unemployment in nursing that influenced a nurse's decision regarding
employment in Texas. A random selection of registered nurses in
Alabama were surveyed as to the conditions that had an effect on
their employment in nursing. Myriads of statistics have been
published to support the claim that there is a nursing shortage.
These statistics are not totally consistent, varying with the date of
publication and the groups or persons surveyed. The average nurse
responding to the questionnaire was a white female, medical-surgical
staff nurse, forty-three years of age with two children. Similari-
ties occurred between the Texas and Alabama studies with unique
differences as well. Both employed and unemployed nurses' responses
differed in such categories as economic benefits, professional role
of the nurse, administrative support and adequacy of working
conditions. The question relating to present employment status
indicates that 69 percent of Alabama nurses are employed full-time
whereas 10 percent are unemployed and not looking for work. Lack
of support given by administrative staff, availability of desired
work schedule and not being able to fulfill family responsibilities
were the main reasons cited for leaving nursing.

DELAYED MUSCLE SORENESS: THE EFFECT OF ICE MASSAGE. Laura Yackzan
Powell, Cara Adams, Kennon Francis, Div. of Physical Therapy, Univ. of
Ala. in B'ham, Birmingham, AL 35294.

The following hypotheses were tested in the present study: 1)
cryotherapy would reduce delayed muscle soreness (DMS) in eccentrically
exercised muscles, 2) early cold treatment would reduce this soreness
more than later post-exercise treatment times, and 3) joint range of
motion (ROM) would be inversely related to the subjective soreness
ratings. Subjective sensations of DMS and changes in elbow joint ROM
were assessed in 30 subjects at 0, 24, 48, and 72 hours following
eccentric-biased exercise in the elbow flexors. Cold treatments were
applied immediately, 24 or 48 hours following a single exercise
session. In response to the eccentric exercise, significant DMS
increases and elbow ROM decreases were observed in all exercised
muscles from 24 to 48 hours post-exercise. No differences in DMS or
elbow ROM changes were observed between treated and untreated arms
except for one. Subjects treated at 24 hours post-exercise reported
greater soreness in their arms compared to untreated arms just prior
to treatment (24 hour post-exercise). The results do not support
the efficacy of cold in reducing DMS. A negative correlation between
DMS and elbow ROM at 48 and 72 hours post-exercise indicated that
an increase in soreness was associated with a decrease in ROM.

CLONING OF (dC-dG)·(dC-dG) SEQUENCES IN pBR322: SIZE DISTRIBUTION
STUDIES. Sonia C. Flores and James W. Gaubatz, Dept. of Biochemistry,
University of South Alabama, Mobile, Alabama 36688

 Duplex DNA of strictly repeating dC and dG sequences is capable of
forming unusual structures, such as left-handed helices, which appear
to be important in genetic regulation. We have investigated the
stability of these sequences in recombinant plasmid molecules.
Derivatives of pBR322 were constructed which contained inserts of
(dC-dG) sequences. These recombinants were characterized by determin-
ing the distribution of insert size and evaluating the subsequent
stability of the inserts. Segments of duplex (dC-dG), containing BamH
I linkers, were ligated with BamH I-phosphatased pBR322 and used to
transfect $E. coli$ HB101. Recombinant plasmids were selected on
ampicillin media. Approximately 2×10^3 ampicillin resistant/tetra-
cycline sensitive clones were obtained per microgram of ligation
mixture. Restriction enzyme screening of 70 clones revealed that all
contained inserts, ranging in size from 14 base pairs (bp) to 59 bp.
In some cases, larger inserts were detected in primary cultures as
minor, diffuse bands. The largest of these unstable inserts averaged
about 70 bp. Further restriction analysis of recombinants representing
various size classes demonstrated that they contained two peripheral
BamH I sites and (dC-dG) sequences of different lengths. Of the most
stable species, the largest insert observed was 50 bp. Thus, the
results indicate that pBR322 derivatives containing tracts of (dC-dG)
longer than 50 bp will spontaneously delete (dC-dG) sequences but not
surrounding pBR322 sequences. (Supported by the Council for Tobacco
Research)

THE INABILITY OF CYPROHEPTADINIUM METHIODINE TO ALTER REPERFUSION
ARRHYTHMIAS IN A CANINE MODEL. David E. Chambers, Guy Patterson,
Arvind K. Shah, James Henderson, and James M. Downey. Department of
Physiology, University of South Alabama, Mobile, AL 36688.

    Cyproheptadine and its quartinized derivative, Cyproheptadinium
methiodide, have been reported to be powerful anti-arrhythmia drugs.
A canine model was developed to test the ability of these two com-
pounds to alter reperfusion arrhythmias after coronary artery occlusion
(CAO). Adult mongrel dogs were anesthetized with sodium pentobarbitol,
and a left thoracotomy performed. The left anterior descending
coronary artery was then completely occluded for a period of 30 min.
followed by 15 min. of reperfusion. Electrocardiographic recordings
were continuously monitored during the ischemic and reperfusion period.
Ventricular arrhythmias were defined as more than 5 ectopic beats per
min. and were classified as early arrhythmias, those occurring 2-12
min. after CAO and late arrhythmias, occurring 14-30 min. after CAO.
There were no significant differences ($p < .05$) in the frequency and
severity of both early and late arrhythmia between the treatment groups
(cyproheptadine: n=10; 30mg-IV; cyproheptadinium methiodide: n=11;
1.5mg-IV) and the control group (n=10). Therefore, the data indicates
that in a canine reperfusion model following 30 min. of complete COA,
cyproheptadine and cyproheptadinium methiodide do not demonstrate a
significant anti-arrhythmic effect.

FREE RADICAL MEDIATED DAMAGE IN REOXYGENATED HEARTS. Ranjan S. Roy, William J. Russell and Joe M. McCord, Dept. of Biochemistry, University of South Alabama, Mobile, AL 36688.
To study the mechanism of reoxygenation damage we have utilized the isolated perfused working rat heart model. Hearts were perfused for a 15 min stabilization period with oxygenated buffer containing glucose. This was followed by 40 min of anoxic substrate-free perfusion after which time the hearts were reoxygenated with the original stabilizing buffer. Perfusate samples were collected at 1 min intervals and assayed for creatine kinase (CK). We introduced, in separate experiments, superoxide dismutase (SOD), catalase and SOD plus catalase into the perfusing buffer. In all rat hearts, release of CK into the perfusate did not commence until the hearts were reoxygenated. Control hearts exhibited a massive release of CK with maximum release following 2 min of reoxygenation. The total amounts of CK release after 10 min of reoxygenation were as follows (in kU/gdw)-control, $10,300 \pm 1060$; SOD, 2500 ± 700; catalase, 3890 ± 420; SOD plus catalase 1450 ± 470. The efficacy of both SOD and catalase suggests that the damaging species is hydroxyl radical ($OH \cdot$). In addition, it was of interest to determine the source of the oxygen-derived free radicals. We have already shown ischemia-induced injury in the cat small intestine to be mediated by $O_2 \cdot^-$ produced by xanthine oxidase (XO). It was conceivable that XO was the source in the heart. Rats were pretreated for 4 days with allopurinol (30mg/kg), a specific inhibitor of XO, and their hearts were subjected to the experimental protocol. Allopurinol (50µM) was also present in the perfusing buffer. The total CK release during 10 min of reoxygenation for allopurinol treated rats was 1380 ± 70 kU/gdw. Thus, xanthine oxidase appears to be the source of free radicals which apparently mediated the cellular damage during reoxygenation.

ADAPTATION OF CONVERGENCE NEURONS IN THE MONKEY. C. A. Tello and L. E. Mays, Neurosciences Prgm., Univ. of Ala. in Birmingham, Birmingham, AL 35294.

The physiological properties of mesencephalic vergence neurons were investigated in awake rhesus monkeys using extracellular recording techniques. Two behavioral conditions were used in this experiment. In the unadapted condition, monkeys were simply required to converge their eyes temporarily by looking at visual targets presented on a mirror stereoscope. In the adapted condition, the monkeys were required to converge their eyes up to 10 deg for 10-30 min. This resulted in a shift in the phoria and a failure of relaxation of vergence in the dark.

In both the adapted and unadapted conditions there was a linear relationship between the firing rate of vergence neurons and vergence angle. However, the firing rate in the adapted state was consistently lower than in the unadapted state. These results suggest a neurophysiological substrate for the dual control theory of vergence proposed by Schor, and have important implications for the understanding of the mechanism for eye alignment.

(Supported by NIH grants RO1 EY03463 and P30 EY03039).

Abstracts

STREPTOZOTOCIN-INDUCED DIABETES MELLITUS INCREASES SUSCEPTIBILITY TO
HERPES SIMPLEX VIRUS INFECTION IN A MURINE ENCEPHALITIS MODEL.
B. Brown and W. B. Davis, University of South Alabama, Mobile, AL
36688.

The effect of hyperglycemia on susceptibility to herpes simplex
virus (HSV) infection was studied using a murine encephalitis model.
Intraperitoneal administration of 200 mg/kg of streptozotocin (STZ)
to 28 day old balb/c mice induced persistent hyperglycemia within
seven days. Subcutaneous HSV-1 (KOS) infection with an inoculum of
1×10^7 PFU resulted in an 80% survival rate among normal animals
($\bar{x}$ blood glucose level 134.8 mg/dl), whereas there were no survivors
among hyperglycemic mice ($\bar{x}$ blood glucose level 340.5 mg/dl). Passive
administration of specific antibody to normal mice provided complete
protection against subcutaneous infection with an HSV-2 (333) inoculum
which was lethal for 40% of normal controls. Protection against HSV-2
infection was not restored in hyperglycemic animals by passive admin-
istration of HSV-2 specific antibody and mean survival times were
reduced as compared to normal HSV-2 infected mice. At seven days
following STZ administration, the in vitro response of spleen cells
from hyperglycemic mice to Con A was equivalent to the response
observed for normal animals. Comparison of viral specific antibody
titers between normal and STZ-treated animals also showed there was no
significant difference at twelve days following inoculation with a
sublethal dose of virus. The results of this study suggest that the
hyperglycemic state impedes in vivo immunologic cooperative inter-
actions which may be necessary to prevent spread of HSV in an infected
host.

ALLOPURINOL-DEPENDENT INHIBITION OF NEUTROPHIL ACTIVATION BY
NEUTROPHILS. Anne Schott, William F. Petrone, Swapan K. Bose, Valera
A. Shannon, Joe McCord, and Harold P. Jones, Department of
Biochemistry, Univ. of South Ala., Mobile, AL   36688.

Superoxide from neutrophils stimulated by serum-treated zymosan A
is inhibited approximately 70% by 1.2 mM allopurinol, while superoxide
production elicited from neutrophils activated with either N-formyl-
methionylleucylphenylalamine (FMLP) or phorbol myristic acetate (PMA)
is unaffected. The quantity of xanthine oxidase in resting and
activated neutrophils was found to be insufficient to account for the
flux of superoxide associated with neutrophil activation. ATP, like
allopurinol, was found to block zymosan-induced superoxide production;
however, it, too, had no effect on superoxide production in FMLP and
PMA-activated neutrophils. Finally, the ability of allopurinol to
block the neutrophil-mediated inflammatory response in carrageenan-
induced foot edema was investigated. While superoxide dismutase was
highly effective in preventing edema, allopurinol had no effect,
indicating its inability to block neutrophil-mediated superoxide
generation in vivo. These results are taken to refute the suggestion
that xanthine oxidase plays a major role in the superoxide production
of activated human neutrophils. (Work supported by a grant from the
Council for Tobacco Research - USA, Inc. and NIH AM 20527).

PLATELET NUMBER AS A DETERMINANT OF CIRCULATION LEVELS OF BETA-THROM-
BOGLOBULIN. Gesina L. Longenecker, Rebecca Bowen, Barbara Beyers and
I. Austin Swift, Pharmacology, College of Medicine, University of South
Alabama, Mobile, AL 36688.

Beta-thromboglobulin is a platelet (P)-specific protein contained in
alpha granules: its physiologic significance is unclear, although B-TG
levels in plasma may be indicative of P condition. B-TG can be released
by thrombin: therefore, blood from smokers (S) and non-smokers (NS) was
allowed to clot (37°, 30 min), after which serum was separated by cen-
trifugation. B-TG was quantitated by radioimmunoassay. S B-TG levels
were significantly (P<.05) higher than NS: 238 ± 5.3, 227 ± 4.7, ng/ml,
respectively. Mechanisms could be 1) increased storage/release per
P or 2) release from a larger number of P. Whole blood P_3 counts were
higher in S than NS (261 ± 15.7 and $239.8 \pm 11.5 \times 10^3/mm^3$, respective-
ly (P<.1). Calculation of B-TG per P yielded $.975 \pm .075$ and $.996 \pm
.045$ ng/10^6P (P>.05). An inverse relationship between serum B-TG and
P count was found, and did not differ between S and NS. Regression
line characteristics for ng B-TG/10^6 P versus P count were

	slope	intercept X	intercept Y
S	-.0041	496.5	2.06
NS	-.0037	509.2	1.88

The mechanism by which elevated serum B-TG levels occur in S is, there-
fore, release from a larger number of platelets. Decreased efficiency
of release as P count increases (due to less thrombin receptor occu-
pancy per P) may attenuate the impact of increased P count. Supported
by grant #1387, Council for Tobacco Research - USA, Inc.

COMMON BINDING SPECIFICITY OBSERVED FOR ETHIDIUM AND ACRIDINE
DERIVATIVES. William J. Firth[*], Jim W. Gaubatz[*] and Lerena W.
Yielding. University of South Alabama College of Medicine, Mobile,
Alabama 36688.

Photoaffinity labeling of pBR322 DNA with an azido derivative of
ethidium bromide (8-azido-3-amino-5-phenyl-6-phenyl-phenanthridinium
chloride) at very limiting drug concentrations, blocked Hha I sites to
generate restriction fragments not usually observed with complete di-
gestion (Coffman et al., J. Biol. Chem. 657:13205-13207). We have now
used photoaffinity labeling with azido acridines, which differ from
ethidium with respect to the specificity of their biological effects,
to correlate binding sequence specificity with biological action. Thus
azido acridines which can cause either frameshift mutagenesis, base-
pair substitution mutagenesis or petite induction and trypanocidal
action were equilibrated with plasmid at the same limiting drug con-
centrations, photoactivated, and restriction analysis was performed.
The same pattern of new restriction fragments was generated as by the
ethidium azide. One non-azido acridine when irradiated also produced
the new digestion fragments. These results indicate that ethidium and
acridines with different biological properties share common binding
characteristics. Therefore, the mechanism of biological actions must
include both the localization of binding and subsequent effects which
may depend on characteristics of the complex. Supported by NIH AI
17683.

THE EFFECTS OF STRESS AND/OR ADRENALECTOMY ON RAT BRAIN N,N-DIMETHYLTRYPTAMINE LEVELS. <u>John M. Beaton</u>, Neurosciences Program & Dept. of Psychiatry, Univ. of Alabama in Birmingham, Birmingham, AL 35294.

Stress has been shown to increase the whole brain levels of N,N-dimethyltryptamine (DMT) and 1,2,3,4-tetrahydro-beta-carboline (THBC) in rat brain and adrenal gland. In this study we measured the brain levels of DMT, THBC, 5-methoxy-N,N-dimethyltryptamine (OMB), tryptamine (TA) and N-methyl-TA (NMT) in groups of control, electric-shock stressed and 21-day individually housed intact and adrenalectomized Sprague-Dawley rats. The levels of the compounds were quantified, simultaneously using an isotopic dilution gas chromatograpy-mass spectrometry assay. The brain tissue samples were homogenized, deproteinated and shaken against 15% isooctane/hexane to remove lipids. The samples were then basified and the indole-alkylamines extracted and derivatized. Six or eight samples were analyzed for each condition. Adrenalectomy alone did not significantly alter the brain indolealkylamine levels, however, DMT levels were significantly elevated in control animals under both stress conditions but not in the adrenalectomized rats. OMB levels were only elevated in the 21-day individually housed adrenalectomized rats. THBC levels were elevated for both stressed groups of intact rats, but only in the 21-day individually housed adrenalectomized rats. These data suggest that under acute stress the increase in brain DMT and THBC may be due to increased release of these compounds from the adrenal glands, whereas with the chronic stress of individually housing, there is also an increase in the synthesis of these agents in brains. (Supported in part by the Alabama Consumer Research Fund).

PHOSPHODIESTERASE ACTIVATOR PROTEIN OF *TURBATRIX ACETI*: PURIFICATION AND COMPARISON WITH CALMODULIN. <u>Devin B. Houston</u>[*] and <u>Roger S. Lane</u>[*]. Dept. of Biochemistry, University of South Alabama, Mobile, AL 36688.

A heat-stable Ca^{2+}-sensitive stimulator of brain cyclic nucleotide phosphodiesterase has been identified in soluble extracts of the free-living nematode *Turbatrix aceti* and purified to apparent homogeneity by $(NH_4)_2SO_4$ precipitation, ion-exchange chromatography and gel filtration. The nematode protein migrates as a single band with an apparent molecular weight of ~19000 when analyzed by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) in the presence of EGTA but chromatographs with Mr ~30000 during gel filtration on Sephadex G-100 suggesting some degree of asymmetry within the molecule. It is capable of fully activating bovine brain phosphodiesterase, shows a Ca^{2+}-dependent mobility shift in SDS-PAGE, is stable to heating at $90°C$, has a pI of 4.1, requires high salt (0.25 M KCl) for elution from a DEAE Bio-Gel A column, and exhibits multiple absorption maxima at 276, 269, 265, and 258 nm characteristic of a high phenylalanine/tyrosine ratio and the absence of tryptophan found in calmodulins. The *T. aceti* protein comigrates with bovine brain calmodulin on isoelectric focusing and SDS gels and closely resembles the brain protein in chromatographic behavior, spectral properties and phosphodiesterase activation activity. The characterization of calmodulin activity in *T. aceti* provides a firm basis for investigation of Ca^{2+}-dependent events in an established model for aging studies. (Supported by NIH Grant AG01002)

P.A.C.T.: HEALTH ASSERTIVENESS FOR CHILDREN. Beth Hutton, Frances Lange and Billie R. Rozell, School of Nursing, University of Alabama in Birmingham, Birmingham, AL 35294.

Quality health care necessitates that health care consumers assume assertive health care seeking behaviors in managing their own self care. Poorly informed and non-assertive consumers contribute to the inflated cost of health care. Individuals must learn to be participating active consumers of health care while they are young, prior to becoming socialized into traditional roles that encourage passive non-assertive attitudes toward health and health care.

The purpose of this study was to determine the effect of portions of Project Health Participatory and Assertive Consumer Training (PACT) on health care assertiveness in fourth grade school children. The study partially replicated a study implemented by the University of Colorado School of Nursing.

Fourth grade students in a county school system (N=100) were pre-tested using the "Health Education Attitude Questionnaire". Preliminary data analysis revealed that the students were homogenous in responding to the questionnaire items. Intervention with one-half of the students was implemented in the classroom setting Winter Quarter, 1984. All students (those receiving health assertiveness intervention and those not receiving intervention) will be post-tested prior to the end of the school year to determine effectiveness of the intervention.

This study was partially supported by a grant from Sigma Theta Tau, Nu Chapter School of Nursing, The University of Alabama in Birmingham.

PHARMACOLOGICAL INTERVENTION AT TWO STAGES OF CALCIUM DEPENDENT TRANSMITTER RELEASE AT THE FROG NEUROMUSCULAR JUNCTION. R. P. Dawkins, H. E. Longenecker, Jr., G. L. Longenecker, Departments of Pharmacology and Computer Science, University of South Alabama, Mobile, Alabama, 36688.

The effects of three compounds (adenosine, 2-Cl-adenosine, and verapamil) on the calcium dependence of quantal transmitter release at the frog sartorius neuromuscular junction were investigated using standard intracellular electrophysiological techniques. All three compounds reduced the quantum content of the stimulus evoked end plate potential, and the effects of all three were antagonized by increased external calcium ion concentration. Under controlled conditions, the quantal release of transmitter was proportional to approximately the third to fourth power of the calcium ion concentration. Adenosine and 2-Cl-adenosine reduced the quantal transmitter release without changing this dependence on calcium. The quantal transmitter release in the presence of verapamil was proportional to approximately the first power of the calcium concentration. In general, the overall kinetics of a multistep process reflect the kinetics of the rate limiting step. It is thus suggested that verapamil and the adenosine analogs inhibit transmitter release at sequential steps in the calcium provocation of transmitter release.

STRATEGIC CAREER PLANNING AND DEVELOPMENT FOR NURSES. Russell C.
Swansburg, College of Nursing, Univ. of South Ala., Mobile, AL
36608. Philip W. Swansburg, Capt., USAF, NC, USAF Medical Center,
Keesler AFB, MS 39534

Until recently, professional nurses made only one major career
decision -- to enter a nursing school. Movement up the ladder
"happened," usually on the basis of seniority with competent,
efficient clinical nurses being pressured to stay put. The authors
have studied the subject of strategic career planning and develop-
ment in nursing and have developed a comprehensive program to guide
professional nurses through a career planning process. This in-
cludes: (1) examination of the wide variety of career options open
to nurses including the advantages, disadvantages, and requirements
of each; (2) evaluation of a nurse's needs and capabilities to
establish short and long range career goals; (3) identification
and obtainment of qualifications needed for job wanted; (4) prep-
aration and advantageous use of an effective resume; (5) conducting
an effective job search; (6) use of effective interview techniques
to make a good impression and get a job; (7) understanding every
stage of the contract negotiation; and (8) mastery of the techniques
for successfully moving up the career ladder. This study examines
techniques, tools and insights related to: (1) the relationship
between strategic career planning and development and success; (2)
navigating through the hidden job market; (3) cultivation of mentor,
peer pal and sponsor relationships; and, (4) developing an effective
coping mechanism to delay or prevent burnout.

MANAGEMENT COMPETENCIES DESIRED OF HEAD NURSES, Russell C.
Swansburg, College of Nursing, Univ. of South Ala., Mobile,
AL 36608.

Head Nurses of wards or units are one of the largest components
of management in the health care system in the United States. The
objective of this study was to identify a list of management com-
petencies which will define the role of the head nurse. A random
sample of Type 1A hospitals that were members of the Alabama
Hospital Association were used. A questionnaire was developed and
submitted to a panel of experts. Administration of the revised
questionnaire indicated that there were significant differences
on 18 of 80 head nurse competencies when ANOVA was used. The
Scheffé post-hoc comparison test and the arithmetic mean indicated
that the hypothesis could be accepted for all 80. There are no
significant differences in head nurse competency ratings among
hospital administrators, nurse supervisors, and head nurses in 14
Alabama hospitals. It was concluded that management competencies
of head nurses can be codefied under the primary management
functions of planning, organizing, directing and controlling
(evaluating). These management competencies can be used for ed-
ucational preparation, recruitment, selection, placement, and
development of professional nurses for head nurse positions. Most
of the validated management competencies are not taught in generic
professional nurse education programs.

A NOVEL ACID SERINE PROTEINASE IN <u>TURBATRIX ACETI</u>. <u>Don W. Bryant</u> and
Roger S. Lane, Dept. of Biochemistry, Univ. of South Alabama, Mobile,
AL   36688.

A new proteolytic enzyme activity that hydrolyzes the chromogenic
chymotrypsin substrate glutaryl-L-phenylalanine p-nitroanilide has
been detected in soluble extracts of the nematode <u>Turbatrix aceti</u> and
purified to electrophoretic homogeneity by acid precipitation, cation-
exchange chromatography and gel filtration.   The purified enzyme
migrates as a single protein band when analyzed either by nondenaturing
polyacrylamide gel electrophoresis at pH 4.3 or by analytical iso-
electric focusing in the pH range of 3 to 10.   It is optimally active
at pH 5.5 and 40°C and is rapidly inactivated above 50°C or at alka-
line pH.   The protease is strongly inhibited by the serine proteinase
inhibitors diisopropylfluorophosphate and phenylmethanesulfonyl
fluoride as well as by the chymotrypsin inhibitors tosylphenylalanine
chloromethyl ketone and chymostatin.   It is also sensitive to inhibi-
tion by p-chloromercuribenzoate and $HgCl_2$ but is insensitive to other
sulfhydryl-blocking reagents, thiols, chelating agents and pepstatin.
The enzyme has an isoelectric point of 7.4 and an apparent molecular
weight of 79,000 by gel filtration.   The protein has a sedimentation
coefficient of 5.2 S, a Stokes radius of 37.5 Å and a frictional ratio
of 1.32, parameters that yield a calculated molecular weight of 80,500.
The protease consists of two dissimilar subunits with molecular
weights of 30,000 (α) and 19,000 (β) present in a 2:1 molar ratio.
The physical properties of the protease indicate that it is a
heterotrimer of subunit composition $\alpha_2\beta$.

ALPHAFETOPROTEIN SECRETION BY A BABOON EMBRYO IN VITRO

Valerie Z. Pope, C. Earle Pope, and Lee R. Beck. Dept. of Obstetrics and
Gynecology, Univ. of Ala. in Birmingham, Birmingham, AL   35294

Alphafetoprotein (AFP), a product of fetal yolk sac and liver, is one of the
original 'oncodevelopmental antigens.' Although the function of this transitory
protein is unknown, various roles such as immunosuppression and molecular
transport have been suggested. Determining the temporal initiation of AFP
secretion could assist investigations of the protein's potential role in the
privileged immune state associated with pregnancy.   Additionally, baboon
embryos have been shown to undergo trophoblast differentiation in vitro that is
sufficiently normal to allow secretion of at least two pregnancy proteins - SP-
1 and chorionic gonadotropin. If cultured baboon embryos are also capable of
secreting AFP in vitro this could indicate functional differentiation of the
inner cell mass, or embryonal cells.   With this objective, baboon embryos
recovered nonsurgically were cultured to postimplantation stages in vitro, and
spent media collected daily was assayed for AFP in an heterologous
radioimmunoassay.   One embryo was shown to secrete AFP in vitro over at
least a 3 day period. A peak of 1.74 ug AFP/day was secreted into the culture
medium 13 days after hatching from the zona pellucida, 9 days after attaching
to the culture dish. The quantity of AFP is significant, particularly compared
to that secreted by cultured hepatoma cell lines. Four other embryos did not
secrete measurable (5 to 10 ng/day) AFP throughout the culture period.
Measurement of AFP secretion, therefore, could prove to be an excellent
monitoring system for the progression of embryonic differentiation in vitro,
which has been shown to be more susceptible to abnormal development than
the less specialized trophoblast cells.

EMBRYO TRANSFER IN THE BABOON

C. Earle Pope, Valerie Z. Pope and Lee R. Beck. Dept. of Obstetrics and Gynecology, Univ. of Ala. in Birmingham, Birmingham, AL 35294

The baboon is a well-established model for human reproduction, but the specific usefulness of these primates in studying pre-and peri-implantation embryology has been limited due to the lack of noninvasive methods for acquiring embryos. Nonsurgical recovery techniques and in vitro culture systems have been developed in this laboratory in the last 5 years, and the experiments made possible by these accomplishments have currently been further expanded by the addition of successful embryo cryopreservation and transfer techniques. The feasibility of nonsurgical embryo transfer in the baboon was initially established by the live birth of a healthy male following transfer of a four-cell uterine embryo. Various cryopreservation methods were then evaluated with 26 embryos. Of six embryos subjected to the same procedure, two pregnancies resulted when the thawed embryos were individually transferred to recipient baboons. A healthy female baboon was born 2/7/84, the result of embryo transfer following cryopreservation for 58 days. The second pregnancy was achieved with an embryo which had been frozen for 22 days, and is due 7/4/84. A live birth following cryopreservation has not previously been reported for primate embryos. The development of successful embryo recovery, culture, cryopreservation and transfer methods in the baboon further enhances the utility of this model for the study of primate embryology. Additionally, the techniques being developed could potentially be used with human embryos in in vitro fertilization clinics as methods of storing supernumery embryos become necessary.

RELATIONSHIP OF SUPPLEMENTAL VITAMIN E TO TOTAL SERUM CHOLESTEROL AND HDL-CHOLESTEROL IN MALE HAMSTERS. Robert E. Keith, Margaret C. Craig-Schmidt and Mieke van den Reek. Department of Nutrition and Foods, Auburn University, AL 36849.

Recent reports have indicated that dietary vitamin E (VIT E) taken in large doses may have beneficial effects on total serum cholesterol (SC) and HDL-cholesterol (HDL-C) levels in humans. In the present experiment 15 mature male hamsters were used to study the effects of supplemental VIT E on SC and HDL-C. Hamsters were housed in individual cages and were fed ad libitum for six weeks a semipurified diet containing 410 IU VIT E/kg diet (experimental group, N=7) or 190 IU VIT E/kg diet (control group, N=8). Food consumption and body weight values were recorded weekly. At the end of the time period animals were sacrificed and blood was obtained via heart puncture. SC and HDL-C values were determined using the Lieberman-Burchard Reaction. HDL-C values were determined in a serum supernatant following precipitation of other lipoproteins with a manganese chloride-heparin solution. There were no differences ($P>.05$) in food consumption, body weights, SC or HDL-C values between the two groups. SC values were 187 ± 19 mg/dl ($\bar{x} \pm SD$) and 196 ± 19 mg/dl for the control and experimental groups, respectively. HDL-C was 80 ± 12 mg/dl for the control group and 80 ± 6 mg/dl for the experimental group. Under the conditions of the present experiment, supplemental VIT E given to hamsters already adequate in VIT E had no effects on SC or HDL-C. Supported by the Auburn University Agricultural Experiment Station.

Abstracts

MERGING OF FACULTY AND CLINICAL RESPONSIBILITIES TO IMPROVE NURSING PRACTICE. Lynne Faulk and Russell Swansburg, College of Nursing and Medical Center, University of South Alabama, Mobile, Al 36688.

An exploratory survey of nursing administrators of nursing programs in Alabama was conducted to document the contemporary occurrence of joint faculty-clinical appointments and their opinions of these attempts to bridge the gap between education and practice. Four of the ten institutions have faculty with joint appointments. There are 4% of 307 faculty with formal education-service responsibilities. Even though one half of the administrators were ambivalent or negative about joint appointments, all identified ways in which faculty keep their practice current: summer or part-time work in clinical agencies, consultation, private practice and continuing education. The majority of the difficulties and benefits of joint appointments identified by the respondents are also those documented in the literature and by the present experience at University of South Alabama. Difficulties included overload and role conflict for faculty and philosophical differences encountered between education and service. Strengths reported were developmental of closer relationships between educational institutions and clinical agencies and the community, better educational experiences provided for students and updating of faculty nursing practice. The additional asset of increasing nursing clinical research was not reported, however is indicated in the literature and supported by the experience at University of South Alabama. Recommendations are for administrative support, better rewards, flexibility, negotiation and mutual planning between education and service.

EVIDENCE FOR AUTOREGULATION OF NEUROTRANSMITTER RELEASE AT THE FROG NEUROMUSCULAR JUNCTION. R. P. Dawkins, H. E. Longenecker, Jr., and G. L. Longenecker, Departments of Pharmacology and Computer Science, University of South Alabama, Mobile, Alabama, 36688.

The effects of adenosine deaminase, isobutylmethylxanthine, and the slowly hydrolysable ATP derivative, Beta,gamma,methylene-ATP (BGMATP) on quantal transmitter release at the frog sartorius neuromuscular junction were studied with standard intracellular electrophysiological techniques. BGMATP reversibly increased the quantum content of the stimulus evoked end plate potential by 34 to 91 percent. Adenosine deaminase, which catalyses the conversion of adenosine to inosine, caused an irreversible increase in the quantum content after a latency of several minutes and reduced the effect of BGMATP. The increase in transmitter release caused by adenosine deaminase could be reversed by the nonhydrolysable adenosine derivative, 2-Cl-adenosine. Isobutylmethylxanthine, an adenosine receptor antagonist, increased the quantum content of the end plate potential.
It is suggested that adenosine produced in the synaptic cleft by the hydrolysis of ATP co-released with the neurotransmitter acetylcholine exerts a negative feedback on the quantal release of transmitter under physiological conditions.

Abstracts

ETHIDIUM MONOAZIDE BINDING SPECIFICITY ON PLASMID DNA. J. Marie
Hardwick and Lerena W. Yielding, Department of Biochemistry, University
of South Alabama, Mobile, Alabama 36688.

Photoaffinity labeling of pBR322 with ethidium monoazide (8-azido-3-
amino-5-ethyl-6-phenylphenanthridinium chloride) was used to provide
evidence for the sequence specificity of ethidium binding to native DNA.
DNA-drug interactions were examined at concentrations of 8 covalently
bound ethidium drugs per molecule of pBR322 (4362 base pairs).
Restriction enzyme cutting was blocked by the covalent binding of a
drug molecule at (or near) the enzyme recognition sequence. This
phenomenon was observed with all restriction enzymes tested and was not
limited to specific regions of the pBR322 molecule. Double digestion
experiments indicated that a drug molecule may bind 2 or 3 base pairs
outside the recognition sequence and still block restriction enzyme
digestion. Intact plasmid was treated with [^{3}H]ethidium monoazide and
digested with restriction enzymes. The amount of covalently-linked
ethidium analog was quantitated for different restriction fragments
and the G-C content of each fragment was determined from the DNA
sequence. In approximately half of the fragments the drug appeared to
preferentially bind at a G-C base pair. However, no preference for
specific sequences such as 5'-C-G-3' was detected, as had been
suggested by previous modeling studies with ethidium bromide. The
other fragments were located in specific map regions of the plasmid and
did not bind drug with a strict dependence on GC content suggesting
that binding specificity may depend on more than one structural
feature of the DNA.

DEVELOPMENT OF NEW TECHNIQUES FOR EVALUATION OF OLFACTORY FUNCTION IN
THE CANINE. Lawrence J. Myers, Auburn University.
Evaluation of olfactory function of the dog or any other domestic
animal in a clinical setting has been limited by the scarcity of
techniques available. The problem has been approached by utilization
of operant conditioning techniques, by utilization of a simple motor
response to a strong odor, and more recently by utilization of the
electroolfactogram.
Two additional techniques have been recently developed to better
evaluate the degree of olfactory function in the dog. One,
electroencephalographic olfactometry, involves the nonspecific
alerting response observed in EEG and EMG activity in response to
various concentrations of odoriferous substances. The other,
behavioral olfactometry, involves observation of characteristic
behaviors in response to various concentrations of odoriferous
substances. Normative thresholds have been obtained and described by
the particular dilution in propylene glycol of eugenol, a compound
known to stimulate primarily the olfactory nerve, or benzaldehyde, a
compound known to stimulate the nasal trigeminal receptors, at a
standard temperature capable of evoking a detectable response. It
was discovered that EEG olfactory provided a more consistent
determination of threshold than behavioral olfactometry and that
threshold for benzaldehyde was more stable than that for eugenol.
In addition, the procedures were validated by demonstrating that
partial ablation of the olfactory mucosa by zinc sulfate treatment
drastically elevates these observed thresholds.

PHASE SPECTRUM OF THE VISUALLY EVOKED EEG RESPONSE AS A MEASURE OF LATENCY. James H. Strickland, Jr. and Louis C. Sheppard, Dept. of Biomedical Engineering, Univ. of Ala. in Birmingham, Birmingham, AL 35294.

The present method of quantifying latency in evoked potential applications is based on measuring the time of occurrence of one of the peaks in the response to the stimulus. We evaluated a latency measurement technique that provides a measure of the phase shift of components of the evoked potential waveform, which may be a better index of time delay. A fast Fourier transform (FFT) technique was used to quantify the phase spectrum of the visual evoked response (VER) elicited by light onset. The VER was monitored in five dogs during anesthesia with halothane in oxygen administered through an endotracheal tube. The increase in latency of the VER waveform due to an increase in end-tidal halothane concentration from 1.2 percent to 2.0 percent was measured using the present method and the proposed phase shift technique. The difference among mean latency values measured with the current method varied from 1 to 18 ms. The mean phase shift at 25 Hz measured with the FFT technique ranged from 2.9 to 3.1 radians. These results support the hypothesis that the phase shift technique is suitable for measuring latency in evoked response studies. Use of the phase information yields more consistent and accurate information about time delay of evoked potential waveforms. This work was supported by the Department of Anesthesiology, University of Alabama in Birmingham.

INCEST AND MOTHER - DAUGHTER ROLE REVERSAL. Mary deChesnay, University of Alabama School of Nursing, University of Alabama in Birmingham, Birmingham, AL 35294.

The scientific community has moved away from discounting the existence of incest to an awareness that incest is prevalent and has deleterious effects. The purpose of this clinical study was to examine the effect of mother - daughter role reversal on length of treatment for father - daughter incest. The sample of twelve families consisted of three groups of four each: role - reversed incestuous families, role - reversed non-incestuous families and role - appropriate incestuous families. Analysis of variance was performed to test the effect of treatment on the number of therapy sessions needed to accomplish therapeutic goals. Results were that reversing roles a second time required significantly fewer sessions than other brief therapy techniques $(\alpha = 0.05)$. It was concluded that therapy goals can be accomplished in fewer sessions when mother - daughter role reversal occurs if the mothers perform selected parental role behaviors with regard to the incest victim. Implications of the study were that mother - daughter role reversal is a worthwhile factor to assess and to consider when treating incest. Nurses who engage in therapy with incestuous families might do well to apply role theory to their treatment of these families. Nurses who are likely to identify incestuous families (i.e. pediatric nurses, emergency room nurses, nurse practitioners) would strenghthen their assessment by looking for data on role reversal and communicating this data to the therapist.

The Effects of Several Eicosanoid Pathway Inhitors On Sodium Arachidonate (AA) Induced Polymorphonuclear Leukocyte (PMN) Aggregation (AGG). Peter C. Panus and <u>Gesina L. Longenecker</u>, Pharmacol. Dept., Univ. of So. Ala., Mobile, AL. 36688

Human PMNs aggregate in response to chemotactic stimuli and diacylglycerols, which release endogenous arachidonic acid, as well as to exogenous arachidonic acid. PMNs were prepared from freshly drawn citrate anti-coagulated blood, after removal of platelets, using Ficoll-Hypaque isolation with NH_4Cl lysis of red cells, and were suspended in Hanks balanced salt solution (HBSS) at 10,000 cells/ul. AGG was assessed nephelometrically (Payton aggregometer, 0% transmission=undiluted suspension, 100%=80% dilution in HBSS) for 100 or 500 ul samples. AGG was stimulated with AA: the supernatants from aggregated samples were assayed for 5-hydroxy-6,8,11,14-eicosatetranoic acid (5-HETE) and thromboxane (TxB_2) by radioimmunoassay (RIA). AA caused a dose dependent increase in AGG and 5-HETE production, and there was a significant correlation (r=0.79) between AGG and 5-HETE. TxB_2 production at low [AA] increased, but at higher [AA] decreased: no significant correlation between TxB_2 and AGG or 5-HETE existed. AGG induced by 0.20 mM AA was modified by several known eicosanoid metabolism inhibitors to determine if their effects on AGG were related to their effects on 5-HETE or TxB_2. Although some drugs demonstrated a close correlation between effects on AGG and eicosanoid metabolism, no overall correlation existed. Conclusion: in PMN, AA-induced AGG and eicosanoid metabolism are parallel but not coupled events.

CALMODULIN AND NEUTROPHIL NAD KINASE. Mary B. Williams and Harold P. Jones, Department of Biochemistry, Univ. of South Ala., Mobile, AL 36688.

The nicotinomide adenine dinucleotide kinase (NAD Kinase) of human neutrophils has been partially purified and characterized. The enzyme which catalyzes the reaction NAD(H) + ATP → NADP(H) + ADP exhibits a broad pH optimum with relatively constant activity observed between pH 6.5 and 9.0. NAD Kinase from neutrophils is strictly dependent upon MG^{2+} and maximal activity is observed at Mg^{2+} concentrations of 5 mM and greater. The kinase has an apparent molecular weight of 169,000 based upon gel filtration.

Crude neutrophil NAD kinase preparations are sensitive to free calcium concentration and are half-maximally activated at free calcium concentrations near ten micromolar. NAD kinase, partially purified by sequential chromatography on Red Agarose, DEAE-Sephacel, and Sephacryl SF-300, is sensitive to calcium and calmodulin. The addition of exxogenous calmodulin and calcium to the preparation results in a 3.5-fold increase in activity. This stimulation of activity by exogenously added calmodulin is blocked by the addition of trifluoperazine. While enhancing the maximum velocity of the reaction, the addition of calmodulin to the kinase has little effect on the binding of either NAD or ATP to the enzyme as judged by K_m values. The K_m values for NAD and ATP in both the presence and absence of calmodulin are approximately 0.5 and 2.0 mM, respectively. (Work supported by a grant from the Council for Tobacco Research - USA, Inc.)

Abstracts

ENGINEERING AND COMPUTER SCIENCE

DEVELOPMENT OF A COMPUTER MEASUREMENT SYSTEM FOR THE ESTIMA-
TION OF BIOPHYSICAL PARAMETERS OF NEUROMUSCULAR
TRANSMISSION. R. P. Dawkins, H. E. Longenecker, Jr., and S.
C. Newman, Departments of Pharmacology and Computer Science,
University of South Alabama, Mobile, Alabama 36688.

A computer software system was developed for the on-
line acquisition of electrophysiological data from an intra-
cellular neuromuscular preparation. The project adhered to
the concept of structured programming and software
engineering with a team approach. The project required over
1500 man-hours of work and produced approximately 2500 lines
of FORTRAN code with 2500 comment lines. The system was
divided into 52 separate modules plus an input/output
library of 13 modules, in the format of FORTRAN subroutines.
Data hiding was accomplished with seven labeled COMMON
blocks, each one only accessible to those modules which
required it. The structured design was maintained in the
source code file by an indented format showing hierarchy
with generous use of comment lines. Thus executed, the
software was easy to maintain when user specifications were
altered.
The software performed as designed. Signal integrity
was assured by testing for a known calibration pulse before
acceptance. The software then automatically measured the
stimulus evoked end plate potential, stored the values, and
averaged the signal. The end plate potential amplitude
values were used for fitting the appropriate binomial model
and thereby estimating the statistical parameters.

A MICROCOMPUTER BASED INFORMATION MANAGEMENT SYSTEM FOR THE
MISSISSIPPI-ALABAMA COASTAL ZONE. Eldon C. Blancher, II and
Robert D. Allen, Interactive Computer Laboratory, University of
South Alabama, Mobile, Alabama 36688.

A Coastal information management system has been developed which
integrates management, bibliographic and basic scientific information
utilizing a micro-computer. The system consists of two distinct
levels, the first of which contains the data base programs, a general
information file, a bibliographic file and a condensed data file with
scientific and management information. The second level consists of a
mainframe data base which is accessed through the micro-computer
system. The distributed data base design makes available a large
variety of data on a single system that is relatively inexpensive to
implement and operate.

Abstracts

SOFTWARE DEVELOPMENT INVOLVING LARGE SYSTEMS. H. E. Longe-
necker, Jr., R. J. Daigle, R. F. Tacon, Jr., Department of
Computer Science, University of South Alabama, Mobile,
Alabama 36688.

Development of a large program or system (>2000 lines)
is relatively unsuccessful with either conventional
programming techniques, or even through adherence to just
the dogma of structured programming. For successful large
system development clear organization at high levels of
abstraction must be readily convertible to structured code.
DATA FLOW analysis enables system wide overview inclusive of
all components. Through decomposition into more detailed
data structures successful expansion of the high level data
flow may proceed. The data flow analysis must be refined to
show precise screen and report formats. Internal data
structures as well as any interfaces to input and output
structures must be visualized and recorded. Then,
hierarchical module control flow can be formulated. From
each module of the hierarchy of modules, top down structured
program units may be designed. Code is generated for each
module beginning at the top or main module, then proceeding
to more distal modules. Module testing and system testing
parallels code development. The above sequence is captured
on a sequence of design instruments completed at each step,
the collection of which instruments with the final code
comprise a system reference manual. Use of the above
procedures facilitates program production in a programming
team environment.

A SIMPLE NUTRIENT LOADING MODEL FOR MISSISSIPPI SOUND: ENVIRONMENTAL
MANAGEMENT IMPLICATIONS. Eldon C. Blancher, II, Interactive Computer
Laboratory, University of South Alabama, Mobile, Alabama 36688

Estimated annual loadings of several constituents (total solids,
total phosphorus, total nitrogen and total organic carbon) to various
subareas of Mississippi Sound and Mobile Bay showed differences
throughout the region which were related to hydrologic inflows and
adjacent coastal developments. Loadings were highest around areas
with substantial urban and industrial developments (Mobile Bay and
Pascagoula) and lowest in those areas with relatively sparse develop-
ment (St. Louis Bay). A statistically significant relationship was
found between individual loadings and the overall water quality in the
adjacent areas ($p < 0.05$). Although the relationship was based on a
small population of samples, it indicated areas of degraded water
quality. A simple loading model constructed on the relationship
may be useful in future environmental management applications.

Abstracts

GENERIC MENU PROCESSING IN A MULTIUSER ENVIRONMENT. R. J. Daigle, H. E. Longenecker, Jr., R. F. Tacon, Jr. Department of Computer Science, University of South Alabama, Mobile, Alabama 36688.

In a multiuser environment general access to data processing functions is impractical from a pragmatic view. It is not desirable to grant access to all functions to every staff member if the integrity of data and programs is to be preserved. Furthermore, the denied request for data processing functions appearing on a users screen may adversely effect the morale of the staff. We have developed a method of allocating access to data processing functions on an individual basis to staff members. Each member is assigned a unique menu set which is a definition of that member's access to the set of data processing functions. A user access maintenance system allows the assignment of access functions to a new staff member, the redefinition of access functions to a current staff member, the removal of access to functions to a previous staff member, and the denial of access to data processing functions for an unauthorized user. The generic menu processor processes any of the menu sets for function selection in a hierarchical manner following log on through a password protected command sequence. Users and the system administrator may alter user passwords to control access to the given menu set.

BARRIERS TO RESOURCE RECOVERY DEVELOPMENT IN ALABAMA. Wayne R. Glass and Sarah Kathryn Farnell, R. L. Wolfe Associates, Montgomery, AL

Barriers to the implementation of municipal resource recovery systems in Alabama are identified and discussed. Although resource recovery development and implemention has progressed significantly in the United States over the past decade, there still exist a number of institutional, political, financial, legal and technical barriers to the timely and economically attractive utilization of waste-to-energy systems. Often, these are specific to the state or the project itself. In Alabama, the planning phase of any project must take into account the Alabama Waste Incineration Act of 1980, and other state environmental regulations. Federal regulations, which sometimes overlap those of the state, must also be reviewed. Examination of the existence of such barriers in Alabama provides valuable guidance to decisionmakers within the State who must consider such barriers in the course of their planning. Methods of confronting and overcoming barriers are considered in light of recent lagislative and financial events.

227

Abstracts

ROBOTIC ARM WORKSPACE FOR TESTING COLLISION AVOIDANCE ENVELOPES.
David J. VanLandingham, Department of Electrical Engineering, Univ. of
South Ala., Mobile, AL 36688.

    While industrial robots offer many advantages for increasing pro-
ductivity and quality, their application to shipbuilding requires dev-
elopment of sensory systems and problem solving algorithms essential
to avoiding collisions. Ship hull sections are too large to efficient-
ly convey past stationary robots as done in automobile assembly lines,
so the robots will have to be mobile and must have effective collision
avoidance systems. Funded by Ingalls Shipbuilding Division of Litton
and by the University of South Alabama Research Committee, a robot
workspace has been developed for testing sensor systems and avoidance
algorithms. The baseline system now being developed uses four station-
ary Polaroid Ultrasonic Ranging units providing protection for a Rhino
XR-2 robotic arm controlled by an Apple IIe computer. The ranging
units are controlled by a SYM-1 single-board computer which passes
range data to the Apple on request. The effectiveness of future im-
provements, additions and alternate approaches can be evaluated in
comparison to the performance of the baseline. In tests of the base-
line thus far, no false starts or stops have occurred nor has the arm
failed to stop when an obstacle was detected or restart when the ob-
stacle was removed. Thirteen percent of the desired protective hemi-
sphere's volume was predicted to be filled by the sensor beams but
only three percent is presently being achieved. Checking range data
for obstacles slows down the arm, increasing its execution time for a
test routine by 154 percent.

A CROSS REFERENCE TECHNIQUE FOR
MULTIPLE ORDERING OF RECORDS

C.L. Friese, Computer Science and Engineering Department, Auburn
University, Auburn, Alabama 36849

    Many applications in data processing utilize files that have multi-
ple keys. These multiple key files are usually implemented utilizing
the alternate key feature of the disc access software. These alternate
key indexes are also known as inverted lists in database terminology.
The technique of "tag" sorting is usually utilized to create the alter-
nate key indexes. This paper describes a method that utilizes the
"tags" as the basis for producing listings of the records in each of
the key orders, such that each listing contains a complete set of cross
references and is accomplished without additional sorting of the rec-
ords. The "tags" and references can be considered as the results of set
function operations from an abstract viewpoint. This technique of pro-
ducing complete cross referencing without additional sorting can save
considerable computer time. Another use for the technique occurs when
an indexed file with alternate keys is reorganized to make one of the
alternate keys a prime key. An extension of the cross referencing
method will generate the new alternate key lists without any additional
sorting.

228

Abstracts

LANGUAGE FEATURE ANALYSIS BY ASP IMPLEMENTATIONS. John Barrett and
Kevin D. Reilly, Dept. of Computer and Information Sciences, Univ. of
Ala. in Birmingham, Birmingham, AL 35294.

A substantial augmentation of a previously acclaimed software
processor, Stage2, has been designed, implemented, analyzed and tested
in a variety of ways. We call this processor ASP (Augmented Stage2
Processor). It has been put to several uses in connection with im-
portant issues in programming language theory and practice, e.g. de-
sign and implementation of a programming language using a formal lan-
guage definition, assessment of language features through implementing
them, and implementation and study of tailored programming tools.
Empirically directed language studies in the ASP context are performed
via implementation, along a continuum from isolated features to kits,
to tailored systems, to applications packages. Isolated features,
used for analysis and experimentation, include, e.g., a control struc-
ture of a high-level language or an aspect of functional programming.
Such analyses are quite limited in purpose, intentionally, but merge
with studies on collections of related features, kits, e.g., all the
control structures of some existing language, or a mixture of popular
control structures from several languages, with a purpose of studying
them as a unit. Collections merge into tailored systems, defined as a
system dedicated to a single purpose or function, e.g. a text editor
or a graphics package. Medium- to large-scale applications involve
selections from all the preceding, and may even incorporate the
development of a new programming language.

INFORMATION MODELING: A NEW CONCEPT IN DATA BASE DESIGN. Rishi R.
Chowdhury, Senior Q.A. Analyst, Federal Express Corporation.

Information Modeling is a top-down approach for defining the
enterprise data resource. It researches, analyzes and records business
policy about data.

The purpose of Information Modeling is to convert our knowledge
of some real-world system into diagrammatic and verbal representation
of the system. It describes business subject matter in terms of the
business entities and relationships that makes up the subject matter.
It is policy oriented instead of process oriented. The principle target
for Information Modeling is Business Function in the corporation.

Information Modeling begins with the concept of Domain of Inform-
ation (DOI), which consists of necessary business activities. After
domains and subdomains are identified, they are drawn in the form
of a hierarchical chart. Then objects and relationships are identified
as entity relationship diagram and defined in each of the subdomains.
Objects in turn become the databases. The data elements are defined
within each objects in the form of Data Element Dictionary. The data
element definitions along with data element dictionary serves as
partial specification for database design.

TOOLS: INCREASING PRODUCTIVITY IN SOFTWARE DEVELOPMENT. <u>R. F. Tacon, Jr., R. J. Daigle and H. E. Longenecker, Jr.,</u> Department of Computer Science, University of South Alabama, Mobile, Alabama 36688.

Given that reliable software can be developed through use of modular design and structured programming techniques, we explored the question how to speed up custom software development. The highest level software would essentially be so abstract so as to have words so powerful that use of only a few would solve whatever problem; thus, such an abstract language would be more efficient than coding in a normal high level language. MANTIS (for IBM 43xx) or DATAFLEX (for the PC) are examples of very high level products affording a high increase in code production per hour, per thought.

We explored an alternate class of solutions which substantially facilitates use of a conventional high level language such as COBOL. We have written and demonstrated programming efficiency with the following systems: 1) Pre-Compilers, 2) Facilitated modular block code entry systems, 3) Program segment "cloning" based on "template" analysis, 4) Code segment generators for FD's, and 5) A menu system for multitasking with secure system component scheduling. All five techniques substantially increase not only the speed of program generation, but more significantly increase the reliability of the programs developed.

ANTHROPOLOGY

ANTHROPOLOGY AND I: EPISODES IN A LONG CAREER. <u>Asael T. Hansen</u>, Dept. of Anthropology, Univ. of Ala., University, AL 35486.

Two pre-career episodes suggest self-selection for anthropology. In 1928 at Wisconsin, I encountered Ralph Linton and anthropology. While still a graduate student, there was a pleasant afternoon with four who were becoming famous: Linton, Herskovits, Mead, and Fortune. Then, Linton introduced me to Robert Redfield who took me to Yucatan. There, 1931-34, I struggled to study Merida, survived, and received some recognition. Came World War II. Edward Spicer recruited me for applied anthropology with evacuated and confined Japanese Americans from 1944-46. Back in Yucatan, 1964-66, I was directing a research field station for all behavioral scientists. After retirement: 1974-77, in Yucatan again as a Mexican anthropological bureaucrat, paid in pesos; May, 1981, honored by the state of Yucatan for a half-century of periodic research there; March, 1983, again with Japanese Americans on the program of an international conference at the University of Utah; October, 1984, a paper in preparation about the haciendas of Yucatan to be given at a World Plantation Conference, part of the New Orleans World Fair. Activities since retirement brought no raise in salary.

SYPHILIS IN MOUND BUILDERS' BONES: A REAPPRAISAL. Mary Lucas
Powell, Department of Anthropology, Northwestern University,
Evanston, IL   60201.

Early research into the antiquity and possible Pre-Columbian
American origin of "syphilis" was traditionally focused upon the
venereally-transmitted form of the treponemal disease (Williams
1932).   Haltom and Shands (1938) discussed "Evidences of Syphilis
in Mound Builders' Bones", presenting examples of osseous lesions
in human skeletal material from the prehistoric Mississippian chief-
dom of Moundville in west central Alabama.   A recently completed
examination of skeletal pathologies in 564 individuals from that
population supports a diagnosis of treponematosis. However, the
form and patterning of observed skeletal involvement suggests an
endemic, non-congenital form more similar to bejel (Hudson 1958)
or yaws (Hackett 1951) than to the venereal form: absence of the
dental malformations pathognomic of congenital syphilis, relatively
high prevalence of moderate localized subperiosteal apposition on
long bone shafts and occasional examples of cranial stellate
lesions of Virchow.   The Moundville pattern corresponds well to
the model of endemic treponematosis developed by Cook (1976) from
research on Illinois Woodland skeletal series.   Evidence from
other regions of North America (Florida, Louisiana, Arkansas, Iowa)
suggests that such a syndrome had been in existence since the
Archaic period.

LATE HISTORIC CREEK ARTIFACTS FROM TALLADEGA COUNTY, ALABAMA.
Craig T. Sheldon, Jr., Dept. of Sociology, Auburn University at
Auburn, Montgomery, AL   36193

The Barclay-White Collection is an assemblage of historic
trade items looted from a presumed Creek Indian grave at the site
of 1TA157 near Talladega, Alabama.   The presence of an 1833 coin
ring indicates that the interment was made shortly before the removal
of the Upper Creeks to Oklahoma.   In relation to earlier 18th century
assemblages, the collection has several significant features
including the increased frequency of clear and blue faceted glass
trade beads, the substitution of driving or wagon bits for riding
bits, and an increased reliance upon U.S. coinage as a source of
silver for ornaments.   These characteristics reflect a continuing
adaptive development of historic Creek culture until the time of
forced removal.

Abstracts

SUBSISTENCE AND ENVIRONMENTAL TRENDS
AT A BRONZE AGE VILLAGE IN JORDAN

Mary C. Metzger, Dept. of History, University of Alabama in Birmingham, Birmingham, AL 35294

This study concerns the role of faunal analysis in archaeological investigations at Tell el-Hayyat, Jordan. Excavation in 1982 and 1983 has resulted in the recovery of more than 22,000 skeletal elements. Of these, some 9,700 could be classified in large taxonomic groupings. The large majority (95%) of identifiable specimens represent domestic ungulates. Sheep and goat remains predominate, followed by those of pigs and cattle. Husbandry techniques used by the villagers to manage these herds included adjusting herd composition and slaughter schedules. Preliminary results suggest that husbandry decisions were made in response to marketing potential as well as village subsistence needs. In either case, animals were generally killed young. Cattle were the exception, and commonly survived to maturity.

Herd structure also presents environmental implications. Evidence for pig husbandry is particularly significant because of that animal's high moisture requirements. Additional climatic indicators are provided by wild faunal remains which represent species extant in the area today. This suggests some similarity between the ancient and modern climate. Field research by the author was supported in part by an AAS Student Research Grant.

COPENA MORTUARY ASSOCIATIONS WITH FIRE.
Kenneth R. Turner, Dept. of Anthropology, Univ. of Ala., University, AL 35486.

A study of 870 small fragments of human bone recovered during controlled screening of soil from within and around two Copena mounds (Site 1Fr311) in northwestern Alabama reveals a high frequency of burnt fragments. Some properties of these burnt bone fragments present strong evidence of cremation (as opposed to adventitious burning), and their distributions suggest that the area between the two mounds was once occupied by a crematory facility. A review of published reports demonstrates that associations of fire, although heretofore underemphasized, are quite common to Copena mounds, and that any general reconstruction of the Copena mortuary schedule must consider the use of fire. Investigators of Copena mounds have tended to concern themselves only with the mounds proper. However, the surrounding area should be excavated as carefully as the mound itself, since the mound may have functioned as one part of a larger mortuary complex.

Abstracts

THE ARCHAEOLOGY OF EUROPEAN-CREEK CONTACTS IN ALABAMA. John W.
Cottier and Gregory A. Waselkov, Dept. of Sociology and Anthropology,
Auburn Univ., Auburn, AL 36849.

Archaeologists at Auburn University recently initiated a comprehen-
sive study of the historic Upper Creek Indians of central Alabama.
The University has assisted by providing a grant for the accumulation
of archaeological and ethnohistorical references on the Creeks. An
extensive collection of both primary and secondary sources has been
indexed, which has provided a reference framework for understanding
selected aspects of European and Indian culture contacts. A review
of the applicable archaeological contextual situations demonstrates
the anthropological importance of this research.

MINUTES

ALABAMA ACADEMY OF SCIENCE
ANNUAL BUSINESS MEETING
University of South Alabama
Mobile, Alabama
March 16, 1984

Report of the Secretary (Dr. Lisano):

TOTAL MEMBERSHIP

Members, March, 1983	774
Members Dropped	130
Members Deceased	3
New Members	141
Members Reinstated	61

Total Membership, March 1984 843

MEMBERSHIP BY SECTIONS

Section	March, 1983	March, 1984	Change
1	210	221	+11
2	63	57	− 6
3	34	35	+ 1
4	23	30	+ 7
5	69	70	+ 1
6	54	66	+12
7	42	41	− 1
8	39	40	+ 1
9	156	187	+31
10	38	47	+ 9
11	27	31	+ 4
99	19	18	− 1

Report of the Gorgas Scholarship Foundation:

"The Gorgas Scholarship Foundation announced today the ranking of the finalists in the 1984 Alabama Science Talent Search. The Search was held at the meeting of the Alabama Academy of Science at the University of South Alabama, Mobile, Alabama.

The winner of the cash award of $1,400 tuition grant was Elizabeth Mallory Landrum, 101 Camellia Drive, Wetumpka, AL 36092, from Edgewood Academy, Elmore, AL; Teacher: Harriet J. Landrum.

Alternates were:
1st (and winner of a $700 tuition grant) Barbara Lynn Baker, 606 Devon Drive, Homewood, AL 35209, from Homewood High School; Teacher: Barbara Murphy.
2nd (and winner of a $500 tuition grant) William Michael Wall, Route 7, Box 167B, Florence, AL 35630, From Bradshaw High School; Teacher: Mary Nell Gonce.

3rd Lee Allen Bullock, 3205 Monte D'Este Way, Birmingham, AL 35216,
     from Resource Learning Center, Shades Valley Annex; Teacher:
     Sophia Clifford
4th Erik John Hunsinger, 411 Chilton Avenue, Florence, AL 35630,
     from Bradshaw High School; Teacher: Mary Nell Gonce.
5th Peggy Anne Murray, 9833 Redmill Road, Birmingham, AL 35235, from
     Huffman High School; Teacher: Beverly A. Long.
6th James Alwyn Jerkins, 323 Louise, Florence, AL 35630, from Brad-
     shaw High School; Teacher: Mary Nell Gonce.
7th Ginger Anne Graves, P.O. Box 567, Opp, AL 36467, from Opp High
     School; Teacher: Elsie Spencer.
8th Elizabeth Locke Beasley, 104 Hastings Road, Athens, AL 35611,
     from Athens High School; Teacher: Sandra I. Caudle.
9th Susan Christine Cox, 125 Lancaster Road, Florence, AL 35630,
     from Bradshaw High School; Teacher: Mary Nell Gonce.

    The rankings were established by a panel of judges consisting of
scientists, department heads, and professors from many of the leading
Universities and industries in Alabama. Dr. Leven S. Hazlegrove,
Professor and Chairman, Department of Chemistry, Samford University,
is Chairman of the Judges Committee.
    Winners and alternates in the Gorgas Contests receive offers of
tuition scholarships to colleges and universities in Alabama for the
study of science. The Gorgas Foundation is named for General William
Crawford Gorgas, the Alabama physician who conquered yellow fever in
the Panama Canal Zone and later became Surgeon General of the U.S.
Army. The purposes of the Foundation are to promote interest in
science and to aid in the education of promising students."

Report of the Nominating Committee:

    The Nominating Committee places in nomination the following:
    Vice President - Dr. Phil Beasley - University of Montevallo
    Treasurer   - Dr. Ray Henry - Auburn University
    AJAS Counselor - Dr. B. J. Bateman - Troy State University
    Board of Trustees - Mr. Richard Peacock - Alabama Power Company
                        Dr. Benjamin Payton - Tuskegee Institute
                        Dr. Sam Barker - University of Alabama B'ham
                        Dr. Joe Thomas - Univ. of North Alabama"

    All nominations were approved.

Report of the Research Committee (Dr. Dixon):

"The following students were given travel awards:
1.	Robert S. Marshall	A.U.	$ 30.00
2.	William Vinson	A.U.	30.00
3.	William Chitwood	A.U.	30.00
4.	Henry E. Moon	U.A.	30.00
5.	George D. Wade	U.A.	30.00
6.	James Bernard	U.A.	30.00
7.	Mary Shields	U.A.B.	30.00

8.	Dan J. Dunmire	U.A.B.	30.00
9.	Robert Burckhalter	U.A.	30.00
10.	Linda Hopkins	U.A.H.	55.00
11.	Mike Cox	A.U.	30.00
12.	Larry Crowell	A.U.	30.00
13.	Shelia Thomas	Tuskegee	30.00
14.	Miryam Miyamoto	U.A.B.	30.00

The following students received awards for the <u>Student</u> <u>Award</u> <u>Competi-</u>
<u>tion</u>:

1.	Robert S. Marshall	A.U.	$ 50.00 Biology Section
2.	Henry E. Moon	U.A.	50.00 Geography Section
3.	Miryam Miyamoto	U.A.B.	50.00 Health Sciences

The following students received the 1984 Alabama Academy of Science
<u>Research</u> <u>Grants</u>:

1.	Henry E. Moon (Dr. J. P. Richetto)	U.A.	$ 200.00
2.	Elizabeth Levson (Dr. M. E. Guy)	U.A.B.	200.00
3.	Robert E. Burckhalter (Dr. D. E. Weaver)	U.A.	200.00
4.	Mike E. Cox (Dr. J. T. Bradley)	A.U.	250.00
5.	Greg J. Harber (Dr. J. T. Bradley)	A.U.	250.00
6.	John C. Dennis (Dr. J. T. Bradley)	A.U.	250.00
7.	Edward E. Wester (Dr. J. T. Bradley)	A.U.	250.00

Report of the Gardner Award Committee (Dr. Mason):

The 1984 recipient of the Gardner Award is Dr. Robert Bauman, a
Physicist from the University of Alabama in Birmingham.

Notes

THE JOURNAL

OF THE

ALABAMA ACADEMY

OF SCIENCE

AFFILIATED WITH THE
AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE

Publication and Subscription Policies

Submission of Manuscripts. Submit all manuscripts and pertinent correspondence to the EDITOR. Each manuscript will receive two simultaneous reviews. For style details, follow Instruction to Authors (see inside back cover).

Reprints: Requests for reprints must be addressed to authors.

Subscriptions and Journal Exchanges: Address all correspondence to the CHAIRMAN OF THE EDITORIAL BOARD.

CONTENTS

CALL FOR NOMINATION
WRIGHT A. GARDNER AWARD

The Wright A. Gardner Award is presented annually by the Alabama Academy of Science for outstanding achievement in science during an individual's residence in Alabama. The award is made at the Annual Meeting. Nominations are now being accepted for 1985.

Academy members are invited to submit nominations for the Gardner Award; however, anyone is eligible to nominate a worthy candidate. A nomination must be accompanied by a typed biography for the nominee and a citation suitable for reading at the time of the presentation. Supporting letters of recommendation are also encouraged. All documentation should be directed to W. H. Mason, 101 Cary Hall, Auburn University, AL 36849. Nomination materials must be received by February 1, 1985.

LETTERS

A Message from the President

I appreciate this opportunity to share with you some feelings and thoughts relative to our Academy of Science. And I hope that you will also share your feelings and ideas.

In the past ten years, our Academy expanded both the quality and scope of its service to the Alabama Junior Academy of Science and affiliated programs. I feel that this has been due in large part to the dedication and devotion of those individuals who have provided continuing dynamic leadership to the AJAS and to the Regional Science Fair Program. During the past few years, however, there has been considerable discussion as to how our Academy might build upon our already strong base in this area and develop additional ways to aid in enhancing science education in our State. This year our Long Range Planning Committee will begin to explore specific mechanisms by which this might be accomplished. Our Academy can and should assume a greater responsibility for providing leadership in science education. Consequently, I hope that you will give this matter your consideration and pass your thoughts along to me so that I might route them to the appropriate committee.

Another area I would like to address involves the size of our membership. For several years the number of active members has steadily increased. This has been due largely to the leadership provided by our section officers, membership committee, and others. However, I feel that we still have not reached our full potential. Significant numbers of individuals throughout the State who have the ability to contribute to our Academy and who in turn could benefit from Academy membership are not an active part of our organization. Additionally, we see many individuals who, after a brief period of membership, become inactive. We need not only to work toward identification of new members, but also to retain on our active lists those who consider leaving the Academy. I would ask that each of us consider what we can do individually or collectively to increase

both the size of our membership and participation in Academy affairs by our membership. Perhaps a key to this involves developing programs which may provide additional benefits to both current and future members. I would add that the continued growth of our Academy and its programs is ultimately dependent upon a committed and interactive membership. I would therefore ask that each of us not only redouble our efforts to make potential members aware of our Academy and its programs but also to let your Academy officers know how we might make our Academy more responsive to the needs of current and future members.

In closing, I would indicate that the Local Arrangements Committee at the University of Alabama, Huntsville, under the leadership of Dr. Jim Horowitz, are doing an outstanding job in planning for our 1984 Annual Meeting in Huntsville. I hope that each of you will make a special effort to attend and to actively participate. We have a strong organization in which we all might take a great deal of pride. But we must have an active, participating membership if we are to continue to contribute to our missions.

Sincerely,
John F. Pritchett, President
Alabama Academy of Science

Academy Plans to Sponsor
Visiting Scientist Program

The Academy has a long tradition of effective participation in science education in the secondary schools of Alabama. The Junior Academy and the Science Fairs are the obvious examples. College and university science faculties have contributed much to these activities over many years. Several years ago the Academy operated a Visiting Scientist Program under the auspices of the National Science Foundation. When funding for such programs stopped, the Academy discontinued its activities. Now, however, with the renewed national concern about education in general and science and mathematics education in particular, it is time for the Academy to broaden the scope of its role in science education, and for more of its members to contribute individually and personally.

Earlier this year the Long Range Planning Committee recommended the establishment of a new Visiting Scientist Program. Although scientists and other professionals now visit classrooms in schools that invite them, there is no statewide organized plan to bring together interested individual scientists and teachers. The Academy will try to set up such a plan. It will involve establishing a list of members who want to participate and a list of teachers and schools who would like to use the members' expertise. More information -- and opportunities to volunteer -- will be forthcoming. But in the meantime, if you are one of those interested scientists, and are willing to contribute some of your time plus the cost of driving occasionally to a not-too-distant school, please write to:

William J. Barrett
Administrative Officer
94 Lucerne Boulevard
Birmingham, Alabama 35209

New Membership Certificates

An attractive new certificate of membership has been developed and is being issued to new Academy members. Any member can obtain a copy of the certificate by sending $1.00 to Dr. Michael E. Lisano, Secretary, Department of Zoology-Entomology, Auburn University, AL 36849. Provide instructions on how you want your name listed on the certificate and the year you joined the Academy. The certificate, suitable for framing, is shown below in a reduced version.

Michael E. Lisano, Secretary
Alabama Academy of Science

The Alabama Academy of Science

An Association
Dedicated to the Development and Advancement of
Science in the State of Alabama since 1924

Certifies
That the Scholarly Accomplishments and Dedication
to the Goals of the Academy Warrant the Election of

Dr. Suzie Q. Personali

As a Member of the Alabama Academy of Science
on this the 1st Day of January, 1984

President
Secretary

FEDERAL REGULATION OF EMPLOYMENT: WHAT BUSINESS
SHOULD KNOW ABOUT AGE, RACE, AND SEX DISCRIMINATION[1]

Renee D. Culverhouse
Department of Management
School of Business
Auburn University at Montgomery
Montgomery, AL 36193

INTRODUCTION

Since the mid-1960's, the federal government has been very interested
in the employment practices of private businesses. The first piece of
federal equal employment legislation to be enacted, the *Equal Pay Act* of
1963, provided equal pay for equal work. Title VII of the *Civil Rights
Act* of 1964 outlawed discrimination in employment practices on the basis
of race, color, religion, sex, or national origin. In 1967, Congress
passed the *Age Discrimination in Employment Act*, modeling it after Title
VII, prohibiting discrimination in employment practices on the basis of
age. Employment, discharge, and promotion (or lack of the same) have all
come under close scrutiny because of such federal legislation. Most of
the claims which have been filed have as their basis a charge of age,
race, and/or sex discrimination. Businesses have been forced to justify
their employment decisions and to prove that such decisions have not been
based in any part on an employee's age, race, or sex. As any employer who
has been challenged can tell you, that is no small burden to bear. This
paper takes a look at how the federal government has regulated employment
practices and offers some practical solutions to dealing with the problem.
It presents a discussion of the most common theories of discrimination,
the proof required in such cases, and the defenses available to the
employer.

ADMINISTRATIVE AND STATUTORY PROVISIONS

Title VII of the 1964 Civil Rights Act. As previously mentioned,
Title VII of the *Civil Rights Act* of 1964 outlaws discrimination in em-
ployment practices on the basis of race and sex. Title VII applies to
employers who employ fifteen or more employees "each working day in each
of twenty or more calendar weeks in the current or preceding calendar
year."[2] This is not limited to full-time employees, but also includes
part-time or CETA employees.[3] Manufacturers' representatives or other
individuals who could be characterized as independent contractors, how-
ever, are not counted.[4] On some occasions, questions may arise as to
whether or not two employers are so closely interrelated that they consti-
tute a single employer, thereby reaching or exceeding the limit. Such
questions are answered by examining the interrelation of operations be-
tween the two companies, centralized control of labor relations, and
common ownership.[5]

Title VII also covers employment agencies, whether or not the agency or individual acting as an agent for the agency operates with or without compensation. Labor organizations are also included in coverage, including to the extent that they are engaged in an industry affecting commerce, including employee representation committees and employee participatory plans concerning grievances, wages, hours, and conditions of employment.[6]

Virtually all employment-related decisions are affected by Title VII. Section 2000e-2(a) provides:

> *It shall be an unlawful employment practice for an employer (1) to fail or refuse to hire or to discharge any individual, or otherwise to discriminate against any individual with respect to compensation, terms, conditions, work privileges because of such individual's race, color, religion, sex, or national origin; or (2) to limit, segregate, or classify employees or applicants for employment in any way which would deprive or tend to deprive any individual of employment opportunities or otherwise adversely affect status as an employee because of such individual's race, color, religion, sex, or national origin.*

"Because of sex" includes "pregnancy, childbirth, or related medical conditions", and it further includes benefits provided by fringe benefit programs.[7]

It has been a practice of some employers to terminate an employee once a charge of discrimination has been alleged. Employers, employment agencies, and joint labor-management committees controlling apprenticeship or other training programs are prohibited from retaliating or discriminating against an individual because such individual has opposed an alleged discriminatory practice or made a charge, testified, or in any manner assisted an investigation or hearing under Title VII.[8]

An exception was built into Title VII, wherein sex may be used as an employment-related factor. Section 2000e-2(e) provides that sex may be an employment factor if it "is a *bona fide* occupational qualification reasonably necessary to the normal operation of that particular business or enterprise." Beware, however, that this provision has been interpreted very narrowly. Customer preference or profitability is not justification for a BFOQ exception.[9]

Charges of employment discrimination in violation of Title VII must be filed with the Equal Employment Opportunity Commission (EEOC) by or on behalf of a person claiming to be aggrieved within 180 days after the alleged discriminatory practice occurred.[10] If the complainant does not appear to meet the 180-day deadline, a further issue to consider is whether or not the violation is continuing in nature. While a discharge case is usually not continuing in nature, sex-based wage discrimination is frequently a continuing violation during the employment relationship.[11] Residual effects of past decisions, such as demotion, transfer, or failure to gain a promotion, do not necessarily constitute a continuing violation.[12]

Equal Pay Act. In 1963, the *Equal Pay Act* was passed as an amendment to the *Fair Labor Standards Act.* Although the administrative, executive, and professional employee exemptions from the FSLA do not apply to the *Equal Pay Act*, the FSLA service and retail industry exemptions do apply.

A claim under the *Act* may be brought within two years after the alleged act occurred, or three years if the act is willful. Willfulness is defined as "Did the employer know the *Fair Labor Standards Act* was in the picture?"[13]   Following such logic, relying on an attorney's incorrect advice may be evidence of a willful violation.[14]

The *Equal Pay Act* specifically states in 29 U.S.C. Sec. 296(d):

> *No employer having employees subject to any provisions of this section shall discriminate, with any <u>establishment</u> in which such employees are employed, between employees on the basis of sex by paying wages to employees in such establishment at a rate less than the rate at which he/she pays wages to employees of the opposite sex in such establishment for <u>equal work</u> on jobs the performance of which requires <u>equal skill</u>, <u>effort</u>, and <u>responsibility</u>, and which are performed under <u>similar working conditions</u>, except where such payment is made pursuant to (i) a <u>seniority system</u>; (ii) a <u>merit system</u>; (iii) a system which measures earnings by <u>quantity or quality of production</u>; or (iv) a differential based on <u>any other factor other than sex</u>; provided, that an employer who is paying a wage rate differential in violation to this subsection shall not, in order to comply with the provisions of this subsection, reduce the wage rate of any employee. (Emphasis supplied.)*

A look at each emphasized element will prove helpful.

Contesting the establishment issue may be a basis for qualifying for the retail or service industry exemption from the *Fair Labor Standards Act*, which exempts retail or service establishments with an annual dollar volume $362,500 or less.   An employee may claim an equal pay violation when comparing his/her wages to those of an employee working for the same employer in a different location.   If there is not centralized control over critical personnel matters, such as hiring, firing, wages, benefits, and scheduling, then there may be a potential of defending an *Equal Pay Act* violation on the establishment question.[15]

In order to recover under the *Equal Pay Act*, it is not necessary for the claimant to show that the jobs were identical, but rather that they were substantially equal.[16]   Instead of proving the jobs identical, the claimant needs to show that the difference in job content is so insignificant that it did not contribute to the pay disparity.

Many employers have attempted to justify wage differentials by claiming that the two employees did not have equal skill.   The courts have defined equal skill to include experience, training, education, and ability.[17]

The factor of equal effort involves the mental or physical exertion necessary to perform the job.   Occasional, incidental tasks are not justification for a difference in pay, such as in the case where female department heads were paid less than male department heads who occasionally unloaded trucks.[18]

The question of equal responsibility involves accountability.   If the buck stops at any one employee and not at the other, the former can receive a greater rate of pay.   In one case, two employees in one department worked closely together for ten years.   The male employee was paid more, legally the court found, because he had greater responsibilities.[19]

Similar working conditions has been held to include job surroundings and hazards. The employee who must work in the more unpleasant surroundings, or whose job involves more hazardous aspects is entitled to greater pay.[20]

Age Discrimination in Employment Act. The number of age discrimination charges filed during 1982 almost doubled the number filed in 1981. This was due to several factors: (1) greater awareness by individuals of their rights against discrimination on the basis of age; (2) the downturn in the economy, which necessitated reduction in force decisions that had an impact on older employees; and (3) dissatisfaction with employment -related decisions where an individual believes that age was a factor in those decisions. According to a recent EEOC survey of age discrimination cases litigated during the past two years, the average age of a claimant is 55 years. Eighty-four percent of age discrimination claimants are male, eighty percent of whom held white collar positions, with an average annual salary of $26,105. Most of the age discrimination cases involve termination/reduction in force issues, with only 22% of the cases concerning issues of hiring, demotion, promotion, compensation, and benefits.[21]

There is a substantial overlap between situations prohibiting discrimination in Title VII and the *Age Discrimination in Employment Act*, 29 U.S.C. Sec. 621 (1967) (as amended), because, as stated earlier, the ADEA was modeled after Title VII. Employers who employ 20 or more employees during each working day for 20 or more calendar weeks in the current or preceding calendar year are covered by the ADEA.[22] Also, employment agencies and labor organizations are prohibited from discriminating on the basis of age.[23]

The *Act* prohibits discrimination against individuals at least 40 and less than 70 years of age.[24] The *Act* provides an exemption for bona fide executives or high paid policymakers, where retirement between ages 65 and 70 is involuntary, and where the individual receives at least $27,000 a year as a retirement income.[25]

The test for determining employee status is very similar to that employed in Title VII. A mere economic relationship between the parties is not sufficient to characterize a relationship as one of employment. Traditional master-servant issues, principally that of control, will determine whether or not an employment relationship exists. This issue becomes very important in cases involving salespeople or manufacturers' representatives.[26]

Prohibitions against discrimination on the basis of age include issues relating to referrals for jobs, hiring, demotions, promotions, and almost any other decision affecting the employment relationship. Further, retaliation against an individual for filing an age discrimination charge, testifying in an age discrimination matter, or participating in an administrative investigation of an age discrimination charge or complaint is unlawful.[27]

Included in the ADEA are three exceptions to the anti-discrimination provisions. They involve the following: (1) *bona fide* occupational qualification; (2) seniority systems or benefit plans; and (3) discharge for good cause.

Age may be considered as a factor where it is a *bona fide* occupational qualification reasonably necessary to the normal operation of the par-

ticular business.[28] Most of the cases involving age and a BFOQ concern safety issues. For example, age was found to be a BFOQ for a state pilot, but was not considered to be a BFOQ for a fireman, or not necessarily a BFOQ for a highway patrolman.[29]

The terms of a *bona fide* seniority system or benefit plan do not violate the ADEA. However, what is a *bona fide* seniority or benefit plan and whether or not those plans are a subterfuge to get around the ADEA would be considered in such a claim.

No matter what any law, state or federal may say, an employer always has the right to discharge an employee who is not performing according to standards, who is insubordinate, or for any other good reason. It is not a violation of the ADEA for an employer to "to discharge or otherwise discipline an individual for good causes."[31] Of course, it is always a factual question of what constitutes "good cause" in each individual case.

An individual believing that discriminatory action occurred on the basis of age must file a charge of discrimination with the EEOC within 180 days after the alleged unlawful practice occurred.[32]

EMPLOYMENT DISCRIMINATION LITIGATION: BURDEN OF PROOF

In order to establish a claim or put forth a defense to such a claim, it is necessary to identify the burden of proof required in such discrimination cases. The burden required in each case depends upon the theory(ies) of discrimination which is used to support a particular claim.

Individual Disparate Treatment. This is the most easily understood theory of discrimination. The employer simply treats some people less favorably than others because of their race, sex, or age. It is critical under such theory that the claimant prove discriminatory motive. There have been some situations, however, in which motive can be inferred from the mere fact of the differences in treatment.[33]

The United States Supreme Court has established the burden of proof required in individual disparate cases in *McDonnell Douglas Corp. vs. Green*, 411 U.S. 792, 802-804 (1973):

> *Plaintiff's Initial Burden: Establish a prima facie case of discrimination on the basis of the protected trait (e.g., race, sex, age).*

> *Defendant's Responses: Employer must articulate some legitimate, non-discriminatory reason for the challenged action.*

> *Plaintiff's Ultimate Burden: Plaintiff must demonstrate that the employer's proffered reason was merely a sham. This is often accomplished by presenting comparative evidence of different treatment accorded similarly situated non-class members.*

In order to make out a *prima facie* case of disparate treatment, the claimant must prove four elements: (1) Plaintiff is a member of a group protected under the statue; (2) Plaintiff applied for and qualified for a job for which the employer was seeking applicants; (3) Plaintiff was rejected despite his/her qualifications; (4) After plaintiff's rejection, the position remained open, and the employer continued to seek persons of plaintiff's abilities.

Once the claimant has made out a *prima facie* case of disparate treatment, the burden then falls on the employer to articulace a business purpose. This simply means that the employer must produce evidence of legitimate, non-discriminatory reason for its action.

At this point, the claimant has an opportunity to show that the employer's proffered reason is a cover-up or sham, so that the discrimination may continue.

Disparate Impact. Disparate impact claims involve employment practices that appear neutral on their face in their treatment of different groups, but that, in fact, impact more harshly on one group than another and cannot be justified by business necessity. Proof of discriminatory motive is not required in such cases.

This type of discrimination is not contingent on the claimant's proof of intent or proof of motive to discriminate. Good intent or the absence of discriminatory intent does not redeem employment procedures or testing mechanisms that operate as "built-in headwinds" for minority groups and are unrelated to measuring job capabilities.[34]

In a disparate impact case, the claimant must show that an employer's practices, though neutral on their face, have a discriminatory effect on a protected group. Usually, this proof is developed statistically by demonstrating the results of the selection procedure (*e.g.*, comparing the pass/fail rates of the selection device on the minority group to the larger group).

Once claimant establishes adverse impact, the employer must show that the selection device has a manifest relationship to the business. The applicable test is not merely whether there is a business purpose for using the challenged practice, but whether there exists an overriding legitimate business purpose, such that the practice is necessary to the safe and efficient operation of the business.[35] Where high levels of economic and human risks are involved (*i.e.*, airplane pilot), proof of the business necessity justification for a challenged practice may be lighter.[36] However, merely an articulation of a business justification is not sufficient in a disparate impact case.

Systematic Disparate Treatment. This theory of discrimination is based on the claim that an employer's employment decisions are tainted by an unlawful, discriminatory motive, so that all persons in the affected class are disadvantaged by the asserted bias. Under this theory, the claimant must establish by a preponderance of the evidence that racial, sexual, or age discrimination was the company's standard operating procedure - the normal rather than the unusual practice. These claims are typically brought as class action.

Such a case proceeds on the theory that a certain employer operates under a generalized theory of discrimination. While the courts have noted the necessity for making out a *prima facie* case of discrimination in such cases, no court has yet specifically identified the precise elements of a prima facie case.

The landmark case under this theory is *Teamsters v. United States*, 431 U.S. 324 (1977). Plantiff's burden in that case was held to be that of establishing by a preponderance of the evidence that racial discrimination is the company's standard operating procedure. This may be done by showing statistics from which an inference of discrimination may be drawn, coupled with a showing of discrete incidents of discrimination.

The employer's best defense is probably to challenge the claimant's statistical showing, or to offer a non-discriminatory explanation for the disparity. Generalized claims of good faith are ineffective. The best "man" for the job is not a sufficient reason to rebut the plaintiff's *prima facie* case. Also, it is not enough merely to articulate a non-discriminatory reason. It must be proven.

The employer always has available to him/her the affirmative defense of *bona fide* occupational qualification. It is appropriate to consider sex or age (but never race) where such is "reasonably necessary to the normal operation of that particular business."[37] It is, however, important to note that the BFOQ burden is on the employer to establish, and the exception is narrowly construed.

Special Consideration in ADEA Cases. As a general rule, age claims follow Title VII principles with reference to burden of proof.[38] However, when the claim involves a reduction-in-force allegation, the claimant is required to show four items in order to make a *prima facie* case: (1) That he/she is in the protected age group; (2) that he/she has been laid off, discharged, or demoted; (3) that he/she was qualified for retention; and (4) through evidence, direct or circumstantial, that the employer intended to discriminate in reaching the decision.[39]

CONCLUSION

As can be seen from the above cited cases and statutes, it has become critical for employers to be able to prove that the man who wasn't hired, the woman who wasn't promoted, and the older employee who was laid off were not singled out because of race, sex, or age. This is impossible to do without documentation. It is imperative that employers keep records, so that they can prove the reason for the employment action taken.

Also, it is important for employers to realize that, even though the company may have an espoused policy of non-discrimination on the basis of age, race, and sex, that in itself is not enough. Upper level management may, indeed, not wish to discriminate, but if that policy is not effectively communicated to the middle and lower level management people, such discrimination will continue to occur. It is vital that employers educate management employees and make understood their policies regarding non-discrimination at all levels of the company. If such action is not taken, an employer may very likely find himself/herself in court, attempting to defend actions which have no defense.

FOOTNOTES

[2]42 U.S.C. Section 2000e(b).
[3]*Hornick v. Burough of Duryea*, 507 F. Supp. 1091 (M.D. Pa 1980).
[4]*Armbruster v. Quinn*, 498 F. Supp. 858 (E.D. Mich. 1980).
[5]*Fike v. Gold Kist, Inc.*, 514 F. Supp. 722 (N.D. Al. 1981).
[6]42 U.S.C. Section 2000e(c), (d).
[7]42 U.S.C. Section 2000e(k).
[8]*Payne v. McLemore's Wholesale and Retail Stores*, 654 F. 1130 (5th Cir. 1981); *Croushorn v. Board of Trustees of the University of Tennessee*, 518 F. Supp. 9 (M.D. Tenn. 1980).

[9]*Wilson v. Southwest Airlines Co.*, 517 F. Supp. 292 (N.D. Texas 1981); *Fernandez v. Wynn Oil Co.*, 26 F.E.P. Cases 815 (9th Cir. 1981).

[10]42 U.S.C. Section 2000e-5(b), (e).

[11]*Hall v. Lendex*30 F.E.P. Cases 83 (6th Cir. 1982).

[12]*McWilliams v. Escambia County School Board*, 658 F. 2d 326 (5th Cir. 1981); *Hamilton v. General Motors Corp.*, 606 F. 2d 576 (5th Cir. 1979); *EEOC v. McCall Corp.*, 24 F.E.P. Cases 437 (6th Cir. 1980).

[13]*Coleman v. Jiffy June Farms, Inc.*, 458 F. 2d 1159 (5th Cir. 1971), *cert. denied*, 409 U.S. 948 (1972).

[14]*Hill v. J.C. Penney Co.*, 688 F. 2d 370 (5th Cir. 1982).

[15]*EEOC v. Maricopa School District*, 28 EPD Sec. 32, 693 (D. Ct. Arizona 1982).

[16]*Spray v. Kellos-sims Crane Rental, Inc.*, 507 F. Suppl. 745 (D. Ct. Ga. 1981); *Orr. v. Frank MacNeil & Son.* 511 F. 2d 166 (5th Cir. 1975).

[17]*EEOC v. Universal Underwriters Insurance Co.*, 653 F. 2d 1243 (8th Cir. 1981).

[18]*EEOC v. Gibson Products Co.*, 28 F.E.P. Cases 676 (D. Ct. Kansas 1981);*EEOC v. Universal Underwriters Insurance Co., supra*

[19]*Hill v. J.C. Penney Co., supra.*

[20]*Corning Glass Works v. Brennan*, 417 U.S. 188 (U.S. Sup. Ct. 1974).

[21]BNA Daily Lab. Rpt. No. 228, A-10 (Nov. 26, 1982).

[22]29 U.S.C. Sec. 630(b).

[23]29 U.S.C. Sec. 630(c), (d).

[24]29 U.S.C. Sec. 631(a).

[25]29 U.S.C. Sec. 631(c) (1).

[26]See *Hickey v. Arkla Industries*, F.E.P. Cases 1719 (5th Cir. 1982).

[27]29 U.S.C. Sec. 623(d).

[28]29 U.S.C. Sec. 623(f) (1).

[29]*Hefelman v. Conservation Department of Missouri*, F.E.P. Cases 1104 (W.D. Mo. 1982); *Orzel v. City of Wauwatosa Fire Department*, 30 F.E.P. Cases 1007 (7th Cir. 1983); *EEOC v. Missouri Highway Patrol*, 30 F.E.P. Cases 1096 (W.D. Mo. 1982).

[30]29 U.S.C. Sec. 623(f) (2).

[31]29 U.S.C. Sec. 623(f) (3).

[32]Although the ADEA was passed as an amendment to the *Fair Labor Standards Act*, which is enforced by the Secretary of Labor, in 1979 the responsibility for enforcing and administering the ADEA shifted to the EEOC.

[33]*Teamsters v. United States*, 431 U.S. 324, 335, n.15 (1977).

[34]*Griggs v. Duke Power Co.*, 401 U.S. 424 (1971).

[35]*Robinson v. Lorillard Corp.*, 444 F. 2d 791, 798 (4th Cir.), *cert. dismissed*, 404 U.S. 1006 (1971).

[36]*E.g., Spurlock v. United Air Lines, Inc.*, 475 F. 2d 216 (10th Cir. 1972).

[37]Section 703(a), Title VII.

[38]See, *e.g., Marshall v. Goodyear Tire & Rubber Co.*, 554 F. 2d 730 (5th Cir. 1977); *Price v. Maryland Casualty Co.*, 561 F. 2d 609 (5th Cir. 1977).

[39]*Williams v. General Motors Corp.*, 656 F. 2d 120 (5th Cir. 1981).

ANOSTRACA IN ALABAMA[1]

Denton Belk
Department of Biology
Our Lady of the Lake University
San Antonio, Texas 78285
and
Walter D. Milne, Jr.
Department of Biological Sciences
University of South Alabama
Mobile, Alabama 36608

ABSTRACT

This note adds *Eubranchipus moorei* Brtek 1967 as the fourth species of Anostraca (Crustacea: Branchiopoda) known to occur in Alabama. The two previously reported *Eubranchipus*, *E. holmani* and *E. vernalis*, inhabit the state's temperate Appalachian Highlands, while *E. moorei* occupies the subtropical Gulf Coastal Plain. Differences in thermal ecology may be limiting these three to their observed ranges. The other anostracan found in Alabama is the widely distributed *Streptocephalus seali*.

INTRODUCTION

The fourth anostracan known to occur in Alabama, *Eubranchipus moorei* Brtek 1967, has a more southern distribution than any other *Eubranchipus* in North America. *Eubranchipus moorei* occurs in St. Tammany Parish, LA (Moore, 1959; called *E. holmani*), Baker County, GA (Dexter, 1953; called *E. holmani*) and Mobile County, AL (this note). These areas are in the Gulf Coastal Plain south of latitude 31° 30' in a region which Moore (1963a) characterizes as, "subtropical and markedly influenced by the Gulf of Mexico." The other eubranchipids found in Alabama, *Eubranchipus holmani* and *Eubranchipus vernalis*, inhabit the temperate Appalachian Highlands in the northern portion of the state. The Alabama populations of both these species are the most southern known. The factors responsible for limiting *E. moorei* to subtropical South Alabama and *E. holmani* and *E. vernalis* to temperate North Alabama are as yet unknown. However, one part of the answer may be found in Modlin's (1982) observation that *E. holmani* and *E. vernalis* did not hatch in his study ponds in years that the basin sediments failed to freeze. Moore (1959; 1963b) does not report any freezing requirement for *E. moorei* in southeastern Louisiana. Baldwin (1973, map 5) presents information that the Gulf Coastal Plain south of latitude 31° 30' experiences an annual mean of less than 30 days with minimum temperatures reaching 0°C or below. The comparable data for the Appalachian Highlands is more than 60 days. Thermal differences between these two regions would also be reflected in water temperatures experienced by active populations. Such differences may be ecologically limiting.

The other anostracan found in Alabama is *Streptocephalus seali*. This is the most widely distributed fairy shrimp in North America, with populations just north of Mexico City, from east to west and north to south across the United States, and in western Canada (Moore, 1966). Physiological races adapted to local ecological conditions are likely important in this anostracan's extensive distribution (Belk, 1977).

METHODS

Specimens were collected by Milne in Mobile County, and additional material was supplied by Dr. Paul Kittle from Lauderdale County, Mr. Oscar Sims from Escambia County, and to Belk by Dr. Richard F. Modlin from Madison County. We thank these individuals for their help. During a visit at the National Museum of Natural History in May 1983, Belk also examined all the Anostraca holdings from Alabama.

RESULTS

Eubranchipus holmani (Ryder) 1880. The first published report of *E. holmani* in Alabama is Modlin's (1982) study of its life cycle and feeding behavior in a temporary pond in Madison County. The only other record is USNM 99396 from Moulton, Lawrence Co. collected 27 March 1954, but not published.

Eubranchipus moorei Brtek 1967. Walter Milne collected the first examples of *E. moorei* from Alabama on the east side of Wilmer Road about 180 m north of Tanner-Williams Road and one mile west of Big Creek Lake in Mobile Co. (T.4S, R.4W, Sec. 3) on 9 March 1980. We deposited voucher specimens collected 28 February 1982, with the Smithsonian Institution (USNM 210511).

Eubranchipus vernalis (Verrill) 1869. Modlin's (1980) list of animals from a forested depression pond in Huntsville, Madison Co. is the first mention of *E. vernalis* in Alabama. Later, he discussed its life cycle and feeding behavior in this and a nearby pond (Modlin, 1982). An unpublished record was collected by G. H. Kiser 3.2 miles southwest of Florence in Lauderdale Co. on 3 March 1979.

Streptocephalus seali Ryder 1879. Creaser (1930) published the first record of an anostracan from Alabama. He probably based his report on specimens of *S. seali* now in the Smithsonian collections as USNM 18813 from Bolling, Butler Co. and labeled as being identified by E. P. Creaser. Dexter (1953) published the next record reporting a July 1945 collection from Baldwin Co. at Silver Hill. The Smithsonian collections contain specimens from two localities in Alabama that have not been published. One, USNM 41844, is from Bridgeport in Jackson Co. The other, USNM 184630, is from Conecuh Co. on the south side of U.S. 84 just east of the Sepulga River. Oscar Sims collected *S. seali* in April 1979, from a pond across the road from T. R. Miller High School at Brewton, Escambia Co. Walter Milne collected specimens 30 August 1982, from Ziegler Pond on Ziegler Boulevard near Springhill Ave. between Forestdale and Foresthill Streets in Mobile. These records place *S. seali* in both the Gulf Coastal Plain and the Appalachian Highlands; not an unexpected result for such a widely distributed species.

LITERATURE CITED

Baldwin, J. L. 1973. *Climates of the United States*. U.S. Department of Commerce, Washington, D.C.

Belk, D. 1977. Zoogeography of the Arizona Fairy Shrimps (Crustacea: Anostraca). J. Arizona Acad. Sci., 12:70-78

Creaser, E. P. 1930. The North American phyllapods of the genus *Streptocephalus*. Occasional papers of the Museum of Zoology, University of Michigan, 217:1-10.

Dexter, R. W. 1953. Studies on North American fairy shrimps with the description of two new species. Amer. Midl. Nat., 49:751-771.

Modlin, R. F. 1980. The physiochemical limnology of a temporary pond in North Alabama. J. Ala. Acad. Sci., 51:119-130.

Modlin, R. F. 1982. A comparison of two *Eubranchipus* species (Crustacea: Anostraca). Amer. Midl. Nat., 107:107-113.

Moore, W. G. 1959. Observations on the biology of the fairy shrimp, *Eubranchipus holmani*. Ecology, 40:398-403.

Moore, W. G. 1963a. Central Gulf States and the Mississippi Embayment. In "Limnology in North America" (D. G. Frey, ed.), pp. 287-300. Univ. Wisconsin Press, Madison, Wisconsin.

Moore, W. G. 1963b. Some interspecies relationships in Anostraca populations of certain Louisiana ponds. Ecology, 44:131-139.

Moore, W. G. 1966. New World fairy shrimp of the genus *Streptocephalus* (Branchiopoda, Anostraca). Southwest. Nat., 11:24-28.

DEVELOPMENT OF *EIMERIA TUSKEGEENSIS* (PROTOZOA: EIMERIIDAE)
FROM THE COTTON RAT, *SIGMODON HISPIDUS*, IN CELL CULTURES[1]

David S. Lindsay[2], William L. Current[3], and Steve J. Upton[4]
Department of Zoology-Entomology
Auburn University
Auburn University, AL 36849

ABSTRACT

The *in vitro* development of *Eimeria tuskegeensis* was examined by
inoculation of sporozoites onto monolayers of primary cell cultures of
cotton rat kidney (PSK), chicken embryo kidney (PCK), and mouse kidney
(PMK) cells, and onto cell lines of human fetal lung (HFL), rabbit kidney
(RK), and porcine testicle (PT). Development to first-generation merozo-
ites occurred in all cell types examined, except RK cells in which only
intracellular sporozoites were observed. Nuclear division occurred in
sporozoites forming sporozoite-shaped meronts with 2 to 8 nuclei. Sporo-
zoite-shaped meronts developed to first-generation meronts which had 7 to
22 nuclei and formed from 8 to 22 first-generation merozoites. Immature
second-generation meronts with 2 to 6 nuclei developed from some first-
generation merozoites in PSK and HFL cell cultures. The development of
second-generation meronts occurred in the same host cell or in new host
cells. Refractile bodies were present in all the developmental stages.

INTRODUCTION

Barnard et al. (1974) described oocysts of 5 species of *Eimeria* from
the cotton rat, *Sigmodon hispidus*, collected in east-central Alabama. The
endogenous development of 3 of these species, *E. sigmodontis*, *E. tuskege-
ensis*, and *E. roperi*, has been described (Ernst et al., 1977; Current et
al., 1981; Whitlock, 1982). Recent reviews on *in vitro* cultivation of
Eimeria reveal that most studies have involved *Eimeria* species infecting
avian, bovine, or ground- squirrel hosts (Doran, 1982; Speer, 1983). Re-
ports by Speer et al. (1970B) on *E. nieschulzi* and Mueller et al. (1973A)
on *E. contorta* are all that has been reported on *in vitro* development of
Eimeria spp. infecting rats. The present study reports the development of
E. tuskegeensis from cotton rats in cell cultures.

MATERIALS AND METHODS

Oocysts of *E. tuskegeensis* used in the present study were from the same isolate used in the description of the endogenous life cycle of this parasite (Current et al., 1981), and have been maintained in our laboratory for 4 years by passage in coccidia-free cotton rats and storage in 2.5% (w/v) potassium dichromate solution at 4°C. Recently passaged oocysts which had been sporulated and stored for 5 to 60 days were used to obtain sporozoites for inoculation onto cell cultures.

Sporozoite preparation

The procedures used to sterilize oocysts and obtain excysted sporozoites for use in culture were similar to those outlined by Speer (1983). Sporozoites were separated from oocyst walls and sporocysts by the column filtration method of Tilahun and Stockdale (1982). Prior to inoculation, sporozoites were suspended in minimal essential medium with Earles salts and L-glutamine (MEME) (GIBCO Laboratories, Grand Island, New York) supplemented with 2% fetal bovine serum (FBS), 100 IU/ml penicillin, and 100 µg/ml streptomycin (antibiotics). Sporozoites were counted in a hemocytometer and the volume of suspension was adjusted to the appropriate level for inoculation onto cell cultures.

Cell cultures

Cell culture terminology used in the present paper conforms to that proposed by Schaeffer (1984). Cells were grown in 8-welled tissue culture chamber slides (Miles Laboratories, Naperville, Illinois) at 37 C° with a 5% CO_2-95% air atmosphere. Primary cell cultures were made from the kidneys of 2, 10-day-old sibling mice (PMK), an 18-day-old chicken embryo (PCK), and an 8-month-old cotton rat (PSK). In addition to these primary cell cultures, cell lines of human fetal lung (passages 28, and 38) (HFL-28, HFL-38), porcine testicle (passage 106) (PT 106), and rabbit kidney (passage 66) (RK 66) were studied. All cells except PSK cells were grown to monolayers in MEME plus 10% FBS and antibiotics. PSK cells were grown in RPMI 1640 medium with L-glutamie (GIBCO Laboratories, Grand Island, New York) supplemented with 20% FBS and antibiotics.

Cell cultures were inoculated with 20,000 sporozoites per well, with the exception of HFL 38 and RK 66 cell lines which received 100,000 sporozoites per well.

Examination of cell cultures

Cell cultures of PSK, HFL 38, and RK 66 were examined 1, 12, 24, 36, 48, 60, 72, 96, and 120 hr post-inoculation (PI). All other cultures were examined 24, 48, 72, and 96 hrs PI. After the appropriate incubation period, the wells and gasket were removed from the glass microscope slide and a 22 by 60 mm coverslip was placed on the monolayer. The culture was then examined by Nomarski interference-contrast (NIC) microscopy. After the living stages had been observed with NIC microscopy, the coverslip was removed and the culture fixed in 100% methanol and stained with Giemsa, or it was fixed in 10% neutral buffered formalin solution and stained with hematoxylin and eosin (H & E). Stained monolayers were examined with

bright-field microscopy. Developmental stages in Giemsa-stained cultures were measured using a calibrated ocular micrometer. Measurements are expressed in micrometers with the mean followed by the range and number (N) of stages measured in parentheses.

RESULTS

Sporozoites of *E. tuskegeensis* released from sporocysts into the excystation solution were motile, undergoing gliding and flexing movements. The sporozoites had a large posterior refractile body located behind the nucleus and a small anterior refractile body located in front of the nucleus (Fig. 1).

Sporozoites penetrated PSK, HFL 38, and RK 66 cells by 1 hr PI (Fig. 2). Sporozoites were located in a parasitophorous vacuole usually next to the host cell nucleus. Multiple penetration of up to 5 sporozoites within a single host cell was observed. In Giemsa-stained preparations, dark staining granules were often located around the anterior refractile body. Refractile bodies of the sporozoites and other developmental stages were eosinophilic with H & E. Sporozoites measured 12.4 by 2.3 μm (10–17 by 2–3, N=50).

Sporozoites were the only stages present in PSK, HEL 38, and RK 66 cell cultures at 12 hr PI. Development beyond intracellular sporozoites did not occur in RK 66 cell cultures, but proceeded to the production of first-generation merozoites in all other cell lines examined.

Development to mature first-generation merozoites occurred by 24 hr PI. Nuclear division in sporozoites resulted in sporozoite-shaped meronts which had from 2 to 8 nuclei and 2 refractile bodies (Fig. 3). These sporozoite-shaped meronts measured 15.1 by 4.3 μm (11–19 by 2–5, N=50) and were nonmotile. As these sporozoite-shaped meronts matured, the number of nuclei increased, and the meront increased in width, forming large elongate or spheroidal first-generation meronts with from 7 to 22 nuclei. First-generation meronts measured 17.3 by 9.4 μm (12–26 by 8–13, N=50). The anterior refractile body disappeared from many meronts during development (Fig. 4), but was retained in other meronts until merozoite formation was initiated (Fig. 5). Refractile bodies were present in first-generation merozoites as they budded from the first-generation meront (Fig. 6). A residual body was often formed after the merozoites had completed budding from the meront. First-generation meronts formed 8 to 22 merozoites which had 2 small refractile bodies located on opposite sides of the nucleus (Fig. 7). Merozoites were crescent-shaped and measured 7.8 by 2.0 μm (6–10 by 1.5–3.0, N=50). Motile intracellular first-generation merozoites were observed in PSK cells but not in any other cell types examined. These merozoites moved around in the parasitophorous vacuole in a circular fashion. Extracellular first-generation merozoites were observed, but they were nonmotile and did not penetrate cells during the course of observation.

Development beyond first-generation merozoites was not observed in PCK, PMK, or PT 106 cell cultures, however, rounded uninucleate second-generation trophozoites were present 48 hr PI in PSK, HFL 28, and HFL 38 cells. These trophozoites had 1 or 2 small refractile bodies and measured 5.2 by 4.2 μm (4–6 by 3–5, N=12). Nuclear division occurred forming small second-generation meronts with 2 to 6 nuclei. Some meronts were formed in
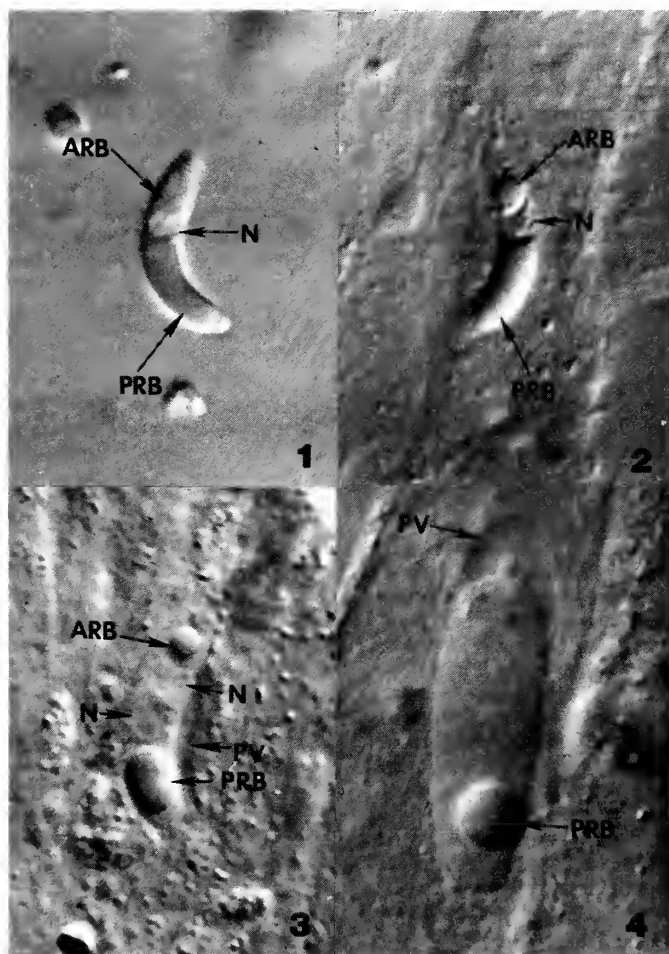
Figures 1-8. Developmental stages of *Eimeria tuskegeensis* in human fetal lung cells. Nomarski interferance contrast. All 2,425 X. Abbreviations: ARB = anterior refractile body, FM = forming first-generation merozoite, M1 = first-generation merozoite, N = nucleus, PRB = posterior refractile body, PV = parastiophorous vacuole, R = residuum, RB = refractile body, M2 = second-generation meront. 1. Sporozoite released from sporocyst prior to inoculation onto cell culture. 2. Intracellular sporozoite, 1 hr PI. 3. Sporozoite-shaped meront containing 2 nuclei, 24 hr PI. 4. Early elongated first-generation meront with prominent posterior refractile body, 24 hr PI.

Development of *Eimeria tuskegeensis* in Cell Cultures
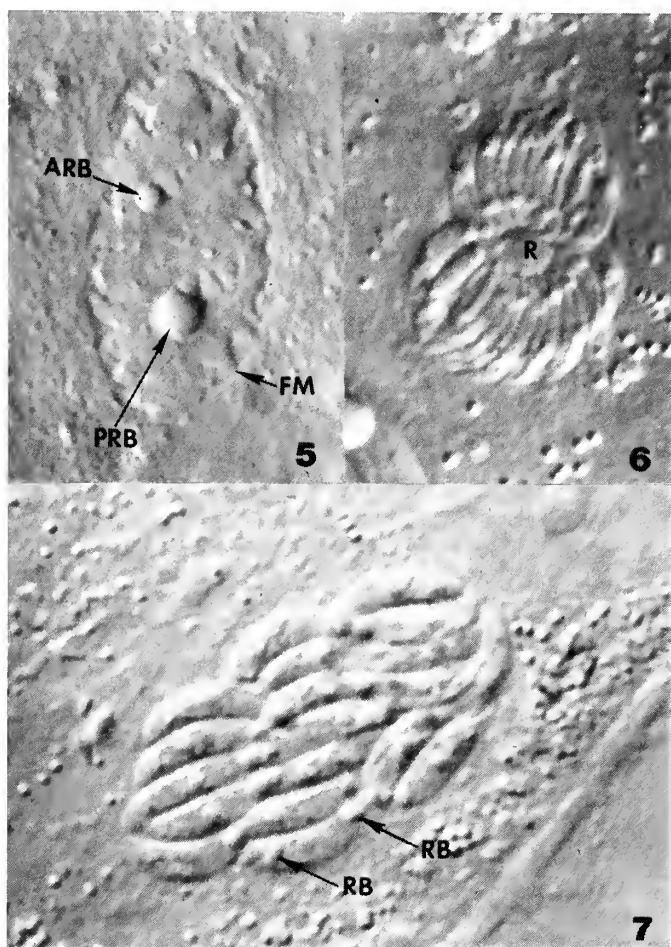
Figures 5-7. 5. First-generation meront with 2 refractile bodies and merozoites forming at periphery, 24 hr PI. 6. First-generation meront in which merozoite formation is almost complete, 24 hr., PI. 7. Group of 19 fully formed first-generation merozoites, 36 hr PI.

the same parasitophorous vacuole that contained the first-generation meronts and merozoites (Fig. 8). Second-generation meronts, observed 48 to 120 hr PI, measured 7.6 by 5.4 μm (5-9 by 4-8, N=22) and had 0 to 2 refractile bodies. Merozoites were not produced by second-generation meronts.

252
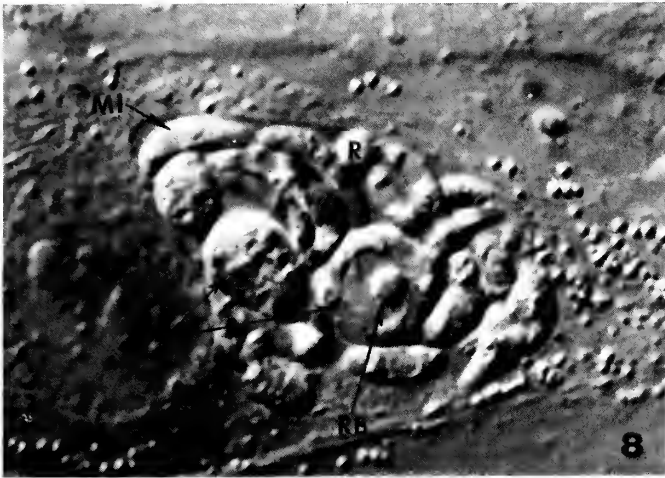
Figure 8. Second-generation meront in same host cell as first-generation merozoites, 48 hr. PI.

DISCUSSION

The present study of the *in vitro* development of *E. tuskegeensis* differs from the *in vivo* report of Current et al. (1981) in that; sporozoite-shaped meronts, meronts containing refractile bodies, merozoites containing refractile bodies; and development of second generation meronts in the same cell as first-generation merozoites, were not observed in enterocytes of experimentally infected cotton rats. The number of merozoites produced by first-generation meronts in the present study was less than that reported by Current et al. (1981). However, most species of mammalian *Eimeria* studied *in vitro* also produced fewer merozoites than occur *in vivo* (Doran, 1982).

Development of sporozoites into sporozoite-shaped meronts *in vitro* has been reported for *E. auburnensis, E. alabamensis,* and *E. canadensis* from cattle (Clark and Hammond, 1969; Sampson and Hammond, 1972; Mueller et al., 1973B), for *E. larimerensis, E. bilamellata,* and *E. callospermophili* from Uinta ground squirrels (Speer and Hammond, 1970; Speer et al., 1970A), for *E. magna* from rabbits (Speer and Hammond, 1971), for *E. vermiformis* from mice (Kelly and Youssef, 1977), and for *E. tuskegeensis* (present study). Of the aforementioned species of *Eimeria,* only *E. auburnensis, E. callospermophili,* and *E. magna* have been shown to form sporozoite-shaped first-generation meronts *in vivo* (Chobotar and Hammond, 1969; Roberts et al., 1970; Speer and Hammond, 1971). Motility has been described for sporozoite-shaped meronts of *E. callospermophili, E. larimerensis, E. magna,* and *E. canadensis in vitro* (Speer and Hammond, 1970, 1971; Mueller and Speer, 1981) but was not observed in sporozoite-shaped meronts of *E. tuskegeensis* (present study), *E. alabamensis, E. auburnen-*

sis, E. bilamellata, or *E. vermiformis* (Clark and Hammond, 1969, Sampson and Hammond, 1972; Speer et al., 1970A; Kelly and Youssef, 1977).

Refractile bodies were present in first-generation merozoites of *E. tuskegensis* (present study) and have been reported for *E. alabamensis, E. callospermophili, E. bilamellata, E. larimerensis, E. magna, E. controta,* and *E. vermiformis in vitro* (Hammond et al., 1970; Speer and Hammond, 1970, 1971; Speer et al., 1970A; Sampson and Hammond, 1972; Mueller et al., 1973A; Kelly and Youssef, 1977). Refractile bodies have been reported *in vivo* for only *E. callospermophili* and *E. magna* (Roberts et al., 1970; Speer and Hammond, 1970). Refractile bodies are composed primarily of protein (Hammond et al., 1968) which accounts for their eosinophilic staining with H & E. The function of refractile bodies is not known (Chobotar and Scholtyseck, 1982). However, a possible explanation of the occurrence of refractile bodies *in vitro* but not *in vivo* is that the availability of amino acids in the culture medium is high enough that the developing meronts use these available amino acids and have no need to catabolize the protein in refractile bodies, whereas *in vivo* the availability of amino acids might be less and the meronts would need to catabolize the protein in their refractile bodies during the formation of merozoites.

Occurrence of second-generation meronts in the original parasitophorous vacuole *in vitro* has been reported for *E. larimerensis* by Speer et al. (1973) and occurs in *E. tuskegeensis* (present study). This phenomenon has not been reported for either species *in vivo*. The second-generation meronts of *E. larimerensis,* which remained in the original parasitophorus vacuole, did not produce second-generation merozoites, whereas those second-generation meronts which developed in cells other than the original did produce second-generation merozoites. These merozoites eventually gave rise to immature gamonts (Speer et al., 1973). In the present study, second-generation meronts which developed in the original host cell parasitophorous vacuole, and those that developed in new cells did not produce second-generation meronts.

Past research on the development of *Eimeria* spp *in vitro* has shown that cell type and passage number influences the development of sporozoites (Doran, 1982). Primary cell cultures from the host usually support the most development, whereas high-passage continuous cell lines (greater than 150 in most cases) usually permit no or less development than do low-passaged cells of the same type. In the present study, all primary cell cultures permitted development of *E. tuskegeensis* sporozoites, but development progressed further (immature second-generation meronts) in kidney cells from the natural host. Growth in the finite cell lines HFL 28 and HFL 38 were similar indicating that the 10 passages did not effect the capacity of these cells to support growth of *E. tuskegeensis*. The HFL cell line appears to be well suited for use in the cultivation of coccidia. In the present study, HFL cells supported development to immature second-generation meronts, as did PSK cells from the natural host. Other studies have demonstrated that HFL cells support the growth of *Isospora suis* and *E. debliecki* from swine (Lindsay et al., 1983, 1984), of *Cryptosporidium* sp from humans and a variety of mammals (Current and Haynes, 1984), and of *Caryospora simplex* from viperid snakes (Upton et al., 1984). Of the cell lines examined, RK 66 was least suitable for development of *E.*

tuskegeensis, permitting only the entry of sporozoites. The high passage continuous cell line PT 106 was also suitable for development of first-generation meronts of *E. tuskegeensis*.

LITERATURE CITED

Barnard, W.P., J.V. Ernst, and C.F. Dixon. 1974. Coccidia of the cotton rat, *Sigmodon hispidus*, from Alabama. J. Parasitol. 60: 406-414.

Chobotar, B., D.M. Hammond, and M.L. Miner. 1969. Development of first-generation schizonts of *Eimeria auburnensis*. J. Parasitol. 55: 385-397.

Chobotar, B., and E. Scholtyseck. 1982. Ultrastructure. Pages 101-165. *in* P.L. Long, ed., The Biology of the Coccidia. University Park Press, Baltimore, Maryland.

Clark, W.N., and D.M. Hammond. 1969. Development of *Eimeria auburnensis* in cell cultures. J. Protozool. 16: 646-654.

Current, W.L., J.V. Ernst, and G.W. Benz. 1981. Endogenous stages of *Eimeria tuskegeensis* (Protozoa: Eimeriidae) in the cotton rat, *Sigmodon hispidus*. J. Parasitol. 67: 204-213.

Current, W.L., and T.B. Haynes. 1984. Complete development of *Cryptosporidium* in cell culture. Science 224: 603-605.

Doran, D.J. 1982. Behavior of coccidia *in vitro*. Pages 229-285, *in* P.L. Long, ed., The Biology of the Coccidia. University Park Press, Baltimore, Maryland.

Ernst, J.V., K.S. Todd, and W.P. Barnard. 1977. Endogenous stages of *Eimeria sigmodontis* (Protozoa: Eimeriidae) in the cotton rat, *Sigmodon hispidus*. Int. J. Parasitol. 7: 373-381.

Hammond, D.M., B. Chobotar, and J.V. Ernst. 1968. Cytological observations on sporozoites of *Eimeria bovis* and *E. auburnensis* and an *Eimeria* from the Kangaroo rat. J. Parasitol. 54: 550-558.

Hammond, D.M., C.A. Speer, and W. Roberts. 1970. Occurrence of refractile bodies in merozoites of *Eimeria* species. J. Parasitol. 56: 189-191.

Kelley, G.L., and N.N. Youssef. 1977. Development in cell cultures of *Eimeria vermiformis* Ernst, Chobotar, and Hammond, 1971. Z. Parasitenkd. 53: 23-29.

Lindsay, D.S., W.L. Current, and T.B. Haynes. 1983. Comparative development of *Isospora suis* in piglets, chicken embryos, and cell cultures. Proceedings of the 4th International Symposium on Neonatal Diarrhea. Oct. 3-5. Saskatoon, Saskatchewan, Canada. pp. 333-341.

Lindsay, D.S., B.L. Blagburn, W.L. Current, and J.V. Ernst. 1984. Development of the swine coccidium *Eimeria debliecki* Douwes, 1921 in mammalian cell cultures. Proceedings of the 37th Annual Meeting of the American Society of Protozoologists, Athens, Georgia. p. 17.

Mueller, B.E.G., D.M. Hammond, and E. Scholtyseck. 1973A. *In vitro* development of first- and second-generation schizonts of *Eimeria contorta* Haberkorn, 1971 (Coccidia, Sporozoa). Z Parasitenkd. 41: 173-185.

Mueller, B.E.G., A.J. DeVos, and D.M. Hammond. 1973B. *In vitro* development of first-generation schizonts of *Eimeria canadensis* (Bruce, 1921). J. Protozool. 20: 293-297.

Mueller, B.E.G., and C.A. Speer. 1981. *Eimeria canadensis*: intracellular motility of a sporozoite-shaped schizont *in vitro*. Proc. Helminthol. Soc. Wash. 48: 87-89.

Roberts, W.L., D.M. Hammond, L.C. Anderson, and C.A. Speer. 1970. Ultrastructural study of schizogony in *Eimeria callospermophili*. J. Protozool. 17: 584-592.

Sampson, J.R., and D.M. Hammond. 1972. Fine structural aspects of development of *Eimeria alabamensis* schizonts in cell cultures. J. Parasitol. 58: 311-322.

Schaeffer, W.I. 1984. Usage of vertebrate, invertebrate and plant cells, tissue and organ terminology. In vitro 20: 19-24.

Speer, C.A. 1983. The coccidia. Pages 1-64, *in* J.B. Jensen, ed., *In vitro* Cultivation of Protozoan Parasites. CRC Press, Inc. Boca Raton, Florida.

Speer, C.A., and D.M. Hammond. 1970. Development of *Eimeria larimerensis* from the Uinta ground-squirrel in cell cultures. Z. Parasitenkd. 35: 105-118.

Speer, C.A., and D.M. Hammond. 1971. Development of first- and second-generation shizonts of *Eimeria magna* from rabbits in cell cultures. Z. Parasitenkd. 37: 336-353.

Speer, C.A., and D.M. Hammond, and L.C. Anderson. 1970A. Development of *Eimeria callospermophili* and *E. bilamellata* from the Uinta ground squirrel *Spermophilus armatus* in cultured cells. J. Protozool. 17: 274-284.

Speer, C.A., D.M. Hammond, and G.L. Kelly. 1970B. Stimulation of motility in merozoites of five *Eimeria* species by bile salts. J. Parasitol. 56: 927-929.

Speer, C.A., D.M. Hammond, and Y.Y. Elsner. 1973. Development of second-generation schizonts and immature gamonts of *Eimeria larimerensis* in cultured cells. Proc. Helminthol. Soc. Wash. 40: 147-153.

Tilahun, G., and H.P.G. Stockdale. 1982. Sensitivity and specificity of the indirect fluorescent antibody test in the study of four murine coccidia. J. Protozool. 29: 129-132.

Upton, S.J., T.B. Haynes, W.L. Current, and S.M. Barnard. 1984. Development of *Caryospora simplex* from sporozoites to oocysts in human fetal lung cell cultures. J. Protozool 31: in press.

Whitlock, S.A. 1982. Biology of *Eimeria roperi* (Apicomplexa, Eimeriidae) in the cotton rat, *Sigmodon hispidus*. Ph.D. Dissertation, Auburn University, pp. 8-29.

ACKNOWLEDGEMENTS

INDEX

Index

1984 Membership Roll by Section

SECTION I
BIOLOGICAL SCIENCES
Abbott-King, Janet
Abee, Christian R.
Adams, Caroline
Albright, C. Wesley
Alexander, Herman D.
Ball, Mary U.
Barker, Steve
Barnes, Rhett, Jr.
Beasley, Philip G.
Benford, Helen H.
Bennett, L. L.
Beyers, Robert J.
Blackmore, Mark S.
Boozer, Reuben B.
Bradley, James T.
Braid, Malcolm
Brannon, Mary Jane
Brown, Burke
Brown, George B.
Brown, Jack S.
Buckner, Richard L.
Buerger, Theodore
Campbell, Olivia
Campbell, P. Samuel
Carter, Gregory A.
Causey, M. Keith
Cheshire, L. Bryan
Chitwood, William
Clelland, Jo
Clements, Ben A.
Cline, George B.
Cochis, Thomas
Collier, Don
Costes, Danice H.
Cox, Michael E.
Creswell, Tom C.
Cross, Earle A.
Crowell, Larry L.
Curl, Elroy A.
Dalrymple, Mary
Darden, William H., Jr.
Davis, Mark S.
Davis, Donald E.
Dawkins, Robert
Dennis, John C.
Denton, Thomas E.
Diener, Urban L.
Dixon, Carl
Dubovsky, Jiri

Dusi, Julian L.
Dusi, Rosemary D.
Edge, Mark T.
Fincher, John A.
Finley, Sara C.
Folkerts, George W.
Frandsen, John C.
Furman, Gary C.
Garstka, William
Gates, William R.
Gauthier, Joseph J.
Gibbons, Ashton
Glaze, Robert P.
Golab, Dorothy K.
Goode, Naaman D.
Grand, Barry
Greene, John
Gudauskas, Robert T.
Halijak, Charles A.
Hancock, Gary
Harbor, Gregory J.
Harper, James D.
Haynes, Thomas B.
Henry, J. Leonard
Henry, Mary M.
Henry, Raymond P.
Holland, Richard D.
Holliman, Dan C.
Hopkins, Linda H.
Hudson, Keith
Hunter, Fiona
Ivey, Tim L.
Ivey, William D.
Jandebeur, Thomas S.
Jensen, Ove W.
Johnston, Carol
Jones, Patricia H.
Kase, Carlos S.
Kelley, Teresa A.
Kendrick, Aaron B.
King, Tommy
Kittle, Paul
Klopfenstein, Miriam
Koon, Karen L.
Koopman, William J.
Kouskolekas, Costas A.
Landers, Kenneth E.
Lawrence, Faye B.
Lelong, Michel G.
Lindsay, David S.
Lisano, Michael E.

Lishak, Robert S.
Lockwood, Susan L.
Mack, Timothy P.
Macmillian, William H.
Mair, Judith Mary
Marion, Ken Roy
Marshall, Robert S.
Martindale, James D.
Mason, William H.
McCord, Joe
McCullough, Herbert A.
McGinty, Douglas T.
McKee, Dorothy W.
McKibbin, John M.
McKinney, Rose B.
McLaughlin, Ellen W.
Meade, Dale
Miller, Margaret
Milne, Walter D.
Mirarchi, Ralph E.
Mitchell, Joan P.
Modlin, Pamela S.
Modlin, Richard F.
Moore, Bobby G.
Moore, Jack H.
Moriarity, Debra M.
Mount, Robert H.
Mullen, Gary R.
Muller, Lisa
Myers, Lawrence J.
Nancarrow, Virginia
Nelson, David H.
Nelson, Fannie
Niedermeier, William
Northrup, Robert S.
O'Kelley, Joseph C.
Okia, Nathan O.
Ottis, Kenneth
Paxton, Mary Jean W.
Peterson, Curt M.
Pierson, J. Malcolm
Pritchett, John F.
Quindlen, Eugene A.
Ramsey, John S.
Ravis, William R.
Richardson, Velma B.
Riley, Thomas N.
Robinson, George H.
Sack, John S.
Sanford, L. G.
Sartin, James L.

Sheffer, Barbara J.
Sheldon, Mary Amy
Shew, H. Wayne
Singh, Shiva P.
Smith, C. E.
Stevens, Clauzell
Strada, Samuel J.
Strickland, Richard C.
Sundermann, Christine
Thompson, W. Joseph
Till, M. L.
Truelove, Bryan
Tucker, Charles E.
Tucker, William H.
Turner, C. J.
Varner, Vera K.
Vinson, William
Vittor, Barry A.
Walker, J. H.
Watson, Jack E.
Whatley, Booker T.
White, Doug
Whitlock, Suzanne
Wilkes, J. C.
Wilkoff, Lee J.
Williams, Ann H.
Williams, Carol S.
Williams, John W.
Williams, George, Jr.
Williams, Michael L.
Wilson, H. J.
Wilson, Mack A.
Wit, Lawrence C.
Yackzan, Kamal S.
Yearwood, Kirtley
Young, Ronald B.

SECTION II
CHEMISTRY
Allen, Roger W.
Arendale, William F.
Barrett, William J.
Beck, Mary Jim
Brown, Mary A. H.
Cappas, Constantine
Chastain, Ben B.
Cooper, E. A.
Corona, Barry
Cottingham, Harry H.
Cox, A. Barry
Dillon, H. Kenneth

Dinius, Robert H.
Finkel, Joe M.
Finley, Wayne H.
Ford, Jonathon
Gaudin, David
Haggard, James H.
Hazlegrove, Leven S.
Ho, Mat H.
Hoffman, Norris W.
Isbell, Raymond R.
Jackson, Margaret E.
Johnson, Robert B.
Kispert, Lowell
Krannich, Larry K.
Lambert, James L.
Laseter, W. Ray
Ledford, Nathan D.
Livant, Peter
Ludwick, Adriane
Mahaffey, C. A. L.
Menikheim, Virginia C.
Miller, Nathan C.
Moeller, Michael B.
Moore, Lisa A.
Moore, McDonald, Sr.
Mountcastle, William
Muller, John H.
Rawlings, Jill
St. Pierre, Thomas
Thomas, Joseph C.
Thompson, W. D.
Toffel, George M.
Toren, E. Clifford, Jr.
Vallarino, Lidia M.
Vigee, Gerald S.
Wakefield, Z. T.
Ward, E. H.
Webb, Thomas R.
Wheeler, G. P.
Whitt, Carlton D.
Youngsblood, Bettye

SECTION III
GEOLOGY
Barnard, Jim
Bearce, Denny
Brande, Scott
Brosheer, Clinton J.
Burckhalter, Robert
Carrington, Thomas J.
Chase, Duane D.

Cranford, Norman B.
Cross, Whitman, II
Daniel, T. W.
Dejarnette, David L.
Gastaldo, Robert A.
Gibson, Michael A.
Gillaspie, Leon W.
Henson, Sharon
King, David T., Jr.
Knight, Steven G.
Lamb, George M.
Lamoreaux, P. E.
Leitner, Barbara J.
McCarty, Charles H.
McMillan, Richard C.
Neilson, Michael J.
Powell, William
Quinn, Kenneth
Stock, Carl W.
Thurn, Richard L.
Usdansky, Steven I.
Wells, Faye

SECTION IV
FORESTRY, GEOGRAPHY,
CONSERVATION, AND
PLANNING
Boyer, William
DeVall, Wilbur B.
Dilsaver, Lary M.
Gibbs, George S.
Goff, Max Marty
Harper, Russell W.
Henderson, H. A.
Himmler, Frank N.
Holland, Andrea P.
Icenogle, David W.
Johnson, Howard P.
Kallsen, Thomas J.
McInnish, Mary K.
Moon Henry E., Jr.
Osterlund, Merilyn J.
Richetto, Jeffery P.
Rivizzigno, Victoria
Sax, Steven R.
Strong, William Reese
Taggart, Martha A.
Tang, R. C.
Weaver, David C.
Williams, Noland C.

SECTION V
PHYSICS AND MATHEMATICS
Alford, William L.
Allison, D. Lee
Ball, Raiford M.
Bateman, B. J.
Bauman, Robert P.
Beiersdorfer, Peter
Carpenter, Randall W.
Chowdhury, Rishi Raj
Christensen, Charles
Colvett, Robert Dee
Curott, David R.
Daneshvar, Kasra
Davis, Jack H.
Dessler, A. J.
Destito, Lou
Dodhy, Adila
Duarte, F. J.
Easterday, Kenneth
Essenwanger, Oskar K.
Forte, Aldo
French, John D.
Furman, W. L.
Glotfelty, Henry W.
Goodall, Marcus C.
Griner, Gary M., Jr.
Harrell, James W., Jr.
Hartman, Richard L.
Hawk, James F.
Helminger, Paul
Hudson, Glenn
Jones, Stanley T.
Kannar, Sher S.
Kaylor, Hoyt M.
Keen, Wayne
Kribel, Robert E.
Lake, James E.
Lundquist, Charles A.
Miyagawa, Ichiro
Morton, Perry W., Jr.
Omasta, Eugene
Piccirillo, John
Polan, Marvin
Rash, Ed
Reid, William J.
Reisig, Gerhard
Robinson, Edward L.
Rowell, Neal
Schroeder, William W.
Shealy, David L.

Shipman, Jerry R.
Smoot, Henrene
Snyder, Robert S.
Sobczyk, Garret
Stewart, Dorothy A.
Sulentic, J. W.
Varghese, S. L.
Vaughan, William W.
Vinson, R. G.
Ward, Charlotte
Weber, F. Neff
Werkheiser, A. H.
Wheeler, R. E.
Wilkinson, E. L.
Williams, John R.

SECTION VI
INDUSTRY AND ECONOMICS
Adrian, John L.
Blevins, Dallas R.
Bobo, James R.
Bressler, Ray B., Jr.
Chastain, E. D.
Chen, Jim
Crawford, Gerald
Culverhouse, Renee
Damtew, Desta
Dilbeck, Sherry
Drake, Albert E.
Friese, Charles, L
Gatlin, Kerry P.
Geer, William D.
Gentle, Edgar C., Jr.
Gibson, Dennis W.
Graves, Benjamin B.
Graves, Katherine M.
Gregorowicz, Philip
Griffin, Marsha D.
Gulley, Charles D.
Harrison, Golson
Haynes, James F.
Heacock, Marian V.
Head, Holman
Jackson, Leslie T.
Johnson, Raymond
Lacy, Wayne
Lake, Robert
Lanning, Joyce A.
Lortie, John W.
Marcus, Norman
Massetti, Brenda L.

McMinn, Nathan E.
Mellichamp, Joseph M.
Miller, David M.
Moberly, H. Dean
Norrell, Fred M.
O'Donnell, Walter G.
Ogburia, Sylvanus
Paul, Chris W.
Prewitt, Lena B.
Rogers, M. R.
Russell, Keith A.
Ryerson, Frank E., III
Schroeder, Edward A., IV
Seldon, James R.
Seldon, Zena A.
Smith, Leon L.
Spencer, C. A., Jr.
Stallings, James L.
Stewart, G. T.
Stockham, Herbert
Viohl, Frederick A.
Walker, William H.
Wiegand, Richard
Wilbourn, Macon
Willhardt, John A.
Zimmerman, Steven M.

SECTION VII
SCIENCE EDUCATION
Bradford, Ibbie King
Bundrick, Linda L.
Catlin, Mentor
Clark, Neil Penton
Coffman, Lindsey F.
Eubanks, Eleanor E.
Fish, Frederick P.
Gonce, Mary N.
Jones, Diana D.
Landers, John I.
Ludwick, Larry M.
McDade, Claudia
Medders, George C., Sr.
Morgan, Anne
Murphy, Barbara
Nall, Jane
O'Brien, James M.
Ormand, Janet
Reynolds, Barbara S.
Riggsby, Dutchie S.
Riggsby, Ernest D.
Rowsey, Robert E.

Schell, Roy H.
Short, William A.
Sie, Swanpo
Simon, Marllin L.
Smith, Joseph W.
Turner, E. J.
Welker, J. D.
Whitson, Dan
Wolfinger, Donna M.

SECTION VIII
SOCIAL SCIENCES
Allen, Lawrence
Buckalew, L. W.
Campbell, Gaine
Cantrell, Clyde H.
Cheng, David G.
Crampton, Roger B.
Dengler, Louise N.
Douty, Helen I.
Dunkelberger, John E.
Elixon, Joseph M., Jr.
Giles, Barbara M.
Hayhurst, Don E.
Inman, Henry F.
Johnson, James A., Jr.
Longnecker, Gesina L.
Longnecker, Herbert E.
Marks, Marsha Kass
Matthews, Josetta B.
Metzger, Mary G.
Myers, John B.
Shields, Mary L.
Sink, David W.
Slattery, Patrick D.
Smith, Frederick P.
Steele, H. E.
Stewart, Walter E.
Summersell, G. G.
Thompson, James J.
Vitulli, William F.
Vocino, Thomas
Weber, B. C.
Yeager, J. H.

SECTION IX
HEALTH SCIENCES
Adams, Gara
Addison, Mark K.
Al-lami, Fadhil A.
Allen, Raleigh H., Jr.

Awtrey, Janet S.
Barker, Samuel B.
Baugh, Charles
Beaton, John M.
Beck, Lee R.
Bergman, Joan S.
Bhatnagar, Yogendra M.
Bolus, David N.
Boots, Larry R.
Boshell, Jerry L.
Braverman, Eleanor B.
Breslin, Frances A.
Britt, Sylvia E.
Brown, Jerry W.
Buckner, Ellen
Carmichael, Emmett
Carmichael, John L.
Carroll, Andrew J., III
Chambers, David E.
Chumney, Sharon
Conary, Jon T.
Cornwell, P. E.
Gosper, Paula
Gowan, Marcia K.
Graig-Schmidt, Margaret
Gulpepper, Michael I.
Gusic, Anne
Dagg, Charles P.
Dashiff, Carol
Davis, Richard
Day, Stephen P.
Dechesnay, Mary
DeRuiter, Jack
Devivo, Michael J.
Douglas, Vera
Elgavish, Ada
Emerson, Geraldine M.
Espy, Patricia
Faulk, Lynne G.
Feng, Teresa
Fitch, James L.
Flores, Sonia C.
Ford, Doris E. Dinkins
Fowler, Elizabeth
Francis, Kennon T.
French, James H.
Furner, Raymond L.
Gardner, William A., Jr.
Gaubatz, Jim W.
Gennaro, Susan
Gibson, Thomas J.

Gilbert, Fred
Gossman, Marilyn
Gueldner, Sarah H.
Hall, Holly K.
Henderson, James D.
Herbert, Donald
Hirschowitz, Basil I.
Hoffman, Henry H.
Holley, Howard L.
Hughes, Edwin R.
Hughes, Glenn H.
Johnson, Evelyn Pointer
Jones, Harold P.
Katz, Judd A.
Keith, Robert E.
Keller, Nancy
Kelley, Jean
Kemppainen, Robert J.
Kidd, William
Kirklin, John W.
Kittrell, Elizabeth J.
Kleinstein, Robert
Lamon, Eddie W.
Lane, Roger S.
Laven, George
Leeper, James D.
Long-Hall, Carolyn K.
Mainland, Rosemary C.
McCallum, Charles
McGlinton, Virginia
McMurry, Fred
Meezan, Elias
Monteiro, Garlos A.
Morgan, Alice H.
Murray, Elizabeth W.
Murry, John
Newell, Charles W.
Nixon, Aileen L.
Oldham, Walter J.
Pace, James C.
Parmentier, James L.
Parsons, Daniel L.
Perry, Nelson
Phillips, J. B., III
Piazza, Dianne
Pierce, John T.
Pieroni, Robert E.
Pillion, Dennis J.
Pirkle, James A.
Pittman, James A., Jr.
Pope, Valerie

274

Notes

Notes

Notes